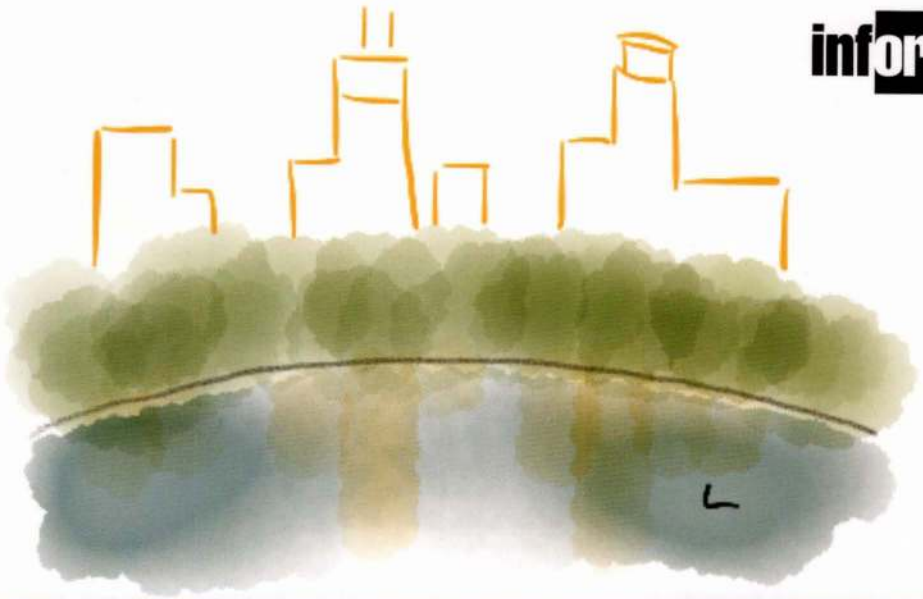
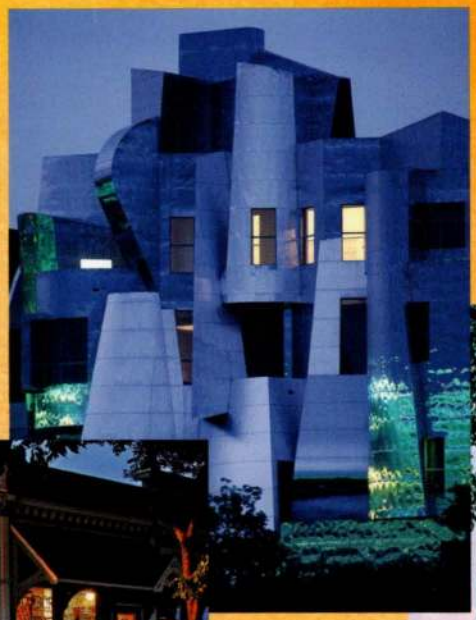


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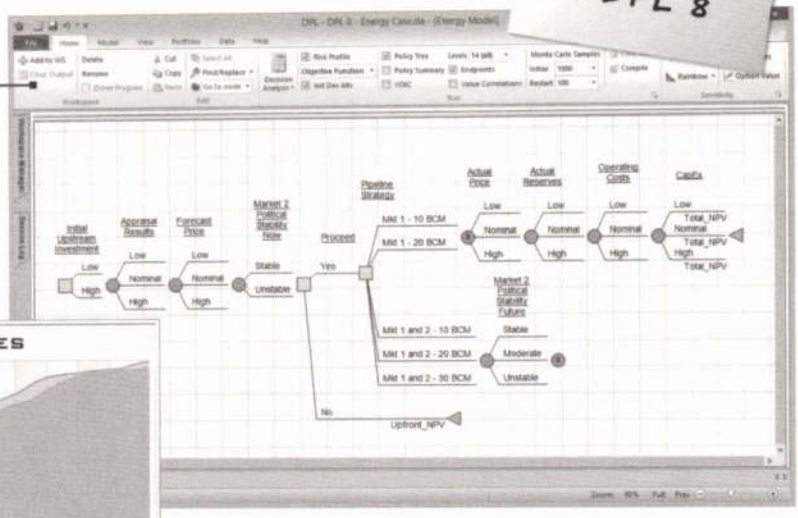




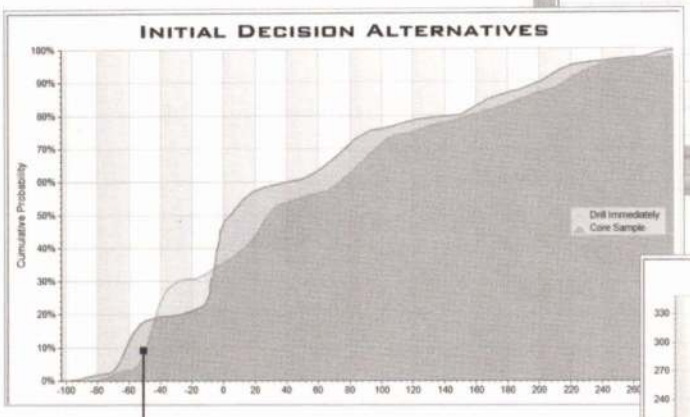
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DPL 8

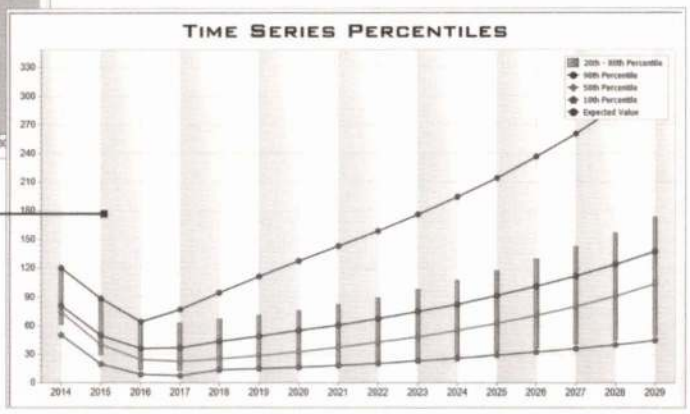
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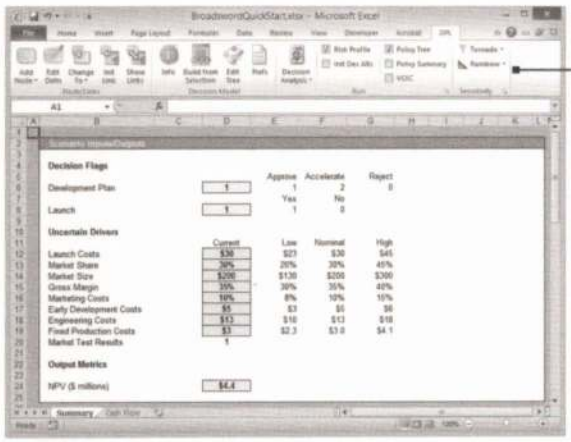


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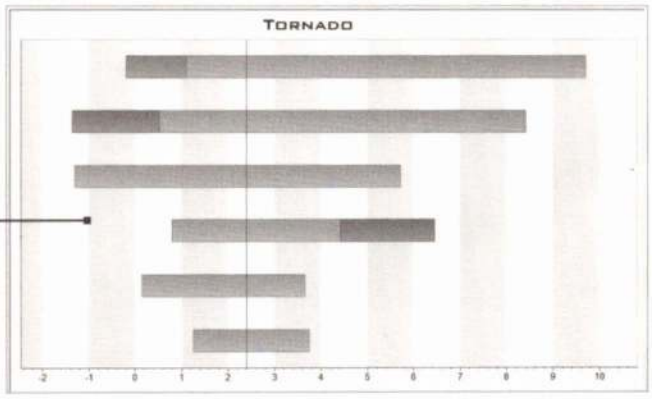


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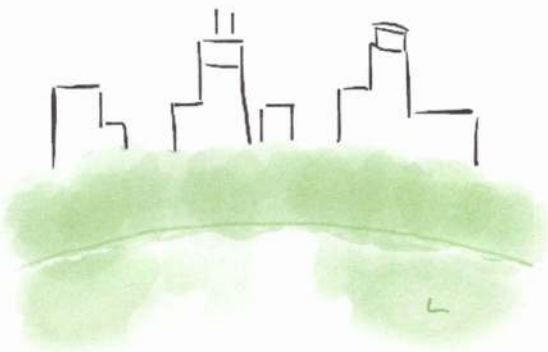
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Dear INFORMS Friends and Colleagues,

Welcome to Minneapolis and the 2013 INFORMS Annual Meeting. You will find Minneapolis–City of Lakes–to be a colorful and stimulating place, and INFORMS Minneapolis offers a vibrant, progressive environment for us to come together, look forward and share and discuss scientific advances.

The strength of our Annual Meeting is its diversity, bringing together experts from industry, academia and government to discuss the latest advances in OR/MS, advanced analytics, and their applications to problems in the public and private sectors. To represent this diversity, we have an outstanding program, including this distinguished set of plenary and keynote speakers:

- Pavel Kabát, Director/CEO, International Institute for Applied Systems Analysis (IIASA) opens the meeting with "Benefits of Systems Science for Policy Support" for global sustainability challenges.
- Anne G. Robinson, Director, Supply Chain Strategy and Analytics, Verizon Wireless, and INFORMS President will present "Advanced Analytics: Empowering Operations Research."
- Lawrence M. Wein, Professor, Graduate School of Business, Stanford University will highlight "Data-Driven Operations Research Analyses in the Public Sector" as the OMEGA RHO Distinguished Lecturer.
- Mark von Oven, Director of Merchandising Analytics, Reporting and R&D, Target Corporation will discuss "The Physics of the Target Guest," highlighting how business analytics is helping to understand customer loyalty and choice.
- Dimitris Bertsimas, Boeing Professor of Operations Research, MIT will present "Health Care Analytics" with applications to diabetes management and the design of clinical trials for cancer.
- Pascal Van Hentenryck, Optimization Research Group Leader, National ICT Australia will present the IFORS Distinguished Lecture, "Computational Disaster Management: The Role of OR/MS."
- Guillermo Gallego, Liu Family Professor, Department of IEOR, Columbia University will highlight advances in "Pricing and Product Design in a Data-Driven Economy."

We also have our Edelman Reprise, UPS George D. Smith Prize, and Wagner Prize presentations.

You won't want to miss the General Reception on Tuesday evening in the Convention Center. This year's theme represents the state's two favorite seasons and settings: Winters in the Cities and Summers Spent Up-North. I hope you'll join us for an evening of food, music and socializing as we capture some of Minnesota's seasonal charms.

I would like to thank many people who have worked tirelessly behind the scenes to make our conference a success, including Terry Cryan, Director of Meetings, Bill Klimack, Meetings Committee Chair and the entire INFORMS Staff. I am grateful to the Organizing Committee, including Bill Cooper, Bob Phillips, Scott Mason, Justin Yates, Kevin Leder, John Gunnar Carlsson, Henry Liu, Hayri Önal, Huseyin Topaloglu, Jim Williams, Stephanie Snyder, Jeff Linderoth, Enno Siemsen, and Shuzhong Zhang, for generously volunteering their time and organizing skills.

I thank our Leadership Sponsors, FICO, Wiley and AIMMS, and corporate and university sponsors, GAMS, The Seth Bonder Foundation, GUROBI Optimization, Purdue University, University of Texas at Dallas, University of Minnesota, Iowa State University, Texas A&M University and LINDO Systems for their generous financial support of our annual meeting.

Finally, I thank you for your support and hope you enjoy the meeting and the city of Minneapolis.

Robert G. Haight

Robert G. Haight, General Chair

NOTE:
All technical sessions are held at the Minneapolis Convention Center, with some special events at the Hilton. Check the Master Track Schedule on pages 46-53 for specific room locations.

KEY
C-Convention Center
H-Hilton

badges required for technical sessions

INFORMS Annual Meeting 2013 badges must be worn to all sessions and events. Badges will be checked at the entrance to technical session areas, as well as the Exhibit Hall. Attendees without badges will be directed to the INFORMS registration desk to register and pick up their badges. All attendees, including speakers and session chairs, must register and pay the registration fee. Lost badges can be replaced at the registration desk for a fee of $5.00.

quick reference

including the Master Track Schedule
Don't miss this handy reference. It's a separate flyer that came with your program. The Master Track Schedule is also printed on pages 46-53.

friday, october 4

6:00pm-8:00pm	Combined Colloquia	H – Marquette Foyer, Fl.2

saturday, october 5

7:30am-5:45pm	CIST Conference	C – 102A-B, Level1
8:00am-6:30pm	DM-HI Workshop	C – 101A-B, Level 1
8:15am-4:30pm	Future Academician Colloquium	H – Symphony 3, Fl.2
8:15am-4:30pm	Future Practitioner Colloquium	H – Symphony 1, Fl.2
8:15am-4:30pm	Teaching Effectiveness Colloquium	H – Symphony 2, Fl.2
9:00am-5:30pm	Vendor (Exhibitor) Workshops	C – See p. 19
11:00am-7:00pm	Registration Opens	C – Exhibit Hall D
5:00pm-6:00pm	INFORMS Membership Meeting	C – 101G-H, Level 1

sunday, october 6

7:00am-5:00pm	Registration	C – Exhibit Hall D
7:30am-5:15pm	CIST Conference	C – 102A-B, Level 1
8:00am-9:30am	Technical Sessions (SA)	Center
9:30am-10:00am	Coffee Break	C – Exhibit Hall D Foyer
10:00am-10:50am	Welcome/Plenary: Pavel Kabát	C – Ballroom A, Level 1
11:00am-12:30pm	Technical Sessions (SB)	Center
12:00pm-5:00pm	Technology Center, Free Internet	C – Exhibit Hall D
12:00pm-5:00pm	Exhibits, Job Fair	C – Exhibit Hall D
12:30pm-1:30pm	Lunch Break (on your own)	
1:30pm-3:00pm	Technical Sessions (SC)	Center
3:10pm-4:00pm	Plenary: Anne G. Robinson	C – Ballroom A, Level 1
4:00pm-4:30pm	Coffee Break	C – Exhibit Hall D
4:30pm-6:00pm	Technical Sessions (SD)	Center
6:15pm-7:15pm	INFORMS Community Meetings	See p. 11
7:30pm-9:00pm	Welcome Reception-Exhibits Open	C – Exhibit Hall D
8:30pm-9:45pm	Awards Ceremony & Dessert Reception	C – Ballroom A, Level 1
	Reception open to ceremony attendees only, doors close at 8:45pm.	

monday, october 7

7:00am-5:00pm	Registration	C – Exhibit Hall D
7:00am-5:00pm	Technology Center, Free Internet	C – Exhibit Hall D
8:00am-9:30am	Technical Sessions (MA)	Center
9:00am-5:00pm	Exhibits, Career Center	C – Exhibit Hall D
9:30am-10:00am	Coffee Break	C – Exhibit Hall D
10:00am-10:50am	Plenary-Omega Rho: Lawrence M. Wein	C – Ballroom A, Level 1
11:00am-12:30pm	Technical Sessions (MB)	Center
12:30pm-1:30pm	Lunch Break (on your own)	
12:30pm-2:30pm	Interactive Session	C – Exhibit Hall D
1:30pm-3:00pm	Technical Sessions (MC)	Center
3:10pm-4:00pm	Keynote: 2013 Edelman Reprise	C – Auditorium 2, Level 1
3:10pm-4:00pm	Keynote: Mark von Oven	C – Auditorium 3, Level 1
4:00pm-4:30pm	Coffee Break	C – Exhibit Hall D
4:30pm-6:00pm	Technical Sessions (MD)	Center
6:15pm-7:15pm	INFORMS Community Meetings	See p. 11

tuesday, october 8

7:00am-5:00pm	Registration	C – Exhibit Hall D
7:00am-5:00pm	Technology Center, Free Internet	C – Exhibit Hall D
8:00am-9:30am	Technical Sessions (TA)	Center
9:00am-5:00pm	Exhibits, Career Center	C – Exhibit Hall D
9:30am-10:00am	Coffee Break	C – Exhibit Hall D
10:00am-10:50am	Plenary: Dimitris Bertsimas	C – Ballroom A, Level 1
11:00am-12:30pm	Technical Sessions (TB)	Center
12:30pm-1:30pm	Lunch Break (on your own)	
12:30pm-2:30pm	Interactive Session	C – Exhibit Hall D
1:30pm-3:00pm	Technical Sessions (TC)	Center
3:10pm-4:00pm	Keynote: 2013 Wagner Prize Winner	C – Auditorium 2, Level 1
3:10pm-4:00pm	Keynote: Pascal Van Hentenryck	C – Auditorium 3, Level 1
4:00pm-4:30pm	Coffee Break	C – Exhibit Hall D
4:30pm-6:00pm	Technical Sessions (TD)	Center
6:15pm-7:15pm	INFORMS Community Meetings	See p. 11
7:30pm-10:00pm	General Reception	C – Exhibit Hall A Lower Level

wednesday, october 9

7:00am-1:00pm	Technology Center, Free Internet	C – Exhibit Hall D
7:00am-3:00pm	Registration	C – Exhibit Hall D
8:00am-9:30am	Technical Sessions (WA)	Center
9:00am-1:00pm	Exhibits	C – Exhibit Hall D
9:00am-3:00pm	Career Center	C – Exhibit Hall D
9:30am-10:00am	Coffee Break	C – Exhibit Hall D
10:00am-10:50am	Keynote: UPS George D. Smith Reprise	C – Auditorium 2, Level 1
10:00am-10:50am	Keynote: Guillermo Gallego	C – Auditorium 3, Level 1
11:00am-12:30pm	Technical Sessions (WB)	Center
12:30pm-1:30pm	Lunch Break (on your own)	
1:30pm-3:00pm	Technical Sessions (WC)	Center
3:00pm-3:30pm	Coffee Break	C – Exhibit Hall D Foyer
3:30pm-5:00pm	Technical Sessions (WD)	Center

coffee breaks

All coffee breaks take place in Exhibit Hall D unless otherwise noted.

Sunday	9:30am-10:00am (Exhibit Hall D Foyer)
	4:00pm-4:30pm
Monday	9:30am-10:00am
	4:00pm-4:30pm
Tuesday	9:30am-10:00am
	4:00pm-4:30pm
Wednesday	9:30am-10:00am
	3:00pm-3:30pm (Exhibit Hall D Foyer)

thank you

Monday Morning Break

Department of Industrial & Systems Engineering
University of Minnesota

Monday Afternoon Break

Iowa State University
Department of Industrial and Manufacturing Systems Engineering

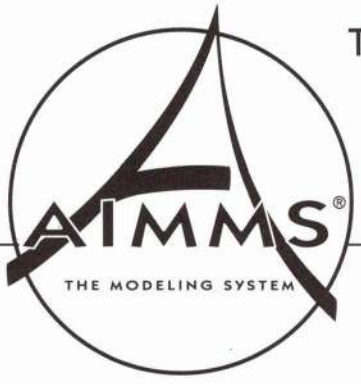
Tuesday Morning Break

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Tuesday Afternoon Break

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Friday, October 4

Combined Colloquium Dinner	HI – Marquette 1-2, Fl.2	6:00pm-8:00pm

Saturday, October 5

Combined Colloquia		
Breakfast	HI – Marquette 1-2, Fl.2	7:00am-8:15am
Future Academician Colloquium	HI – Symphony 3, Fl.2	8:15am-4:30pm
Future Practitioner Colloquium	HI – Symphony 1, Fl.2	8:15am-4:30pm
Teaching Effectiveness Colloquium	HI – Symphony 2, Fl.2	8:15am-4:30pm
Lunch	HI – Marquette 1-2, Fl.2	11:45am-1:15pm
Colloquia Dinner	C – Seasons, Level 2	7:00pm-9:00pm
Meetings Committee	HY – Suite 2425	7:30am-11:30am
DM-HI Workshop Breakfast	C – 101C, Level 1	8:00am-8:30am
DM-HI Workshop	C – 101A & 101B, Level 1	8:30am-6:30pm
DM-HI Lunch/Speaker	C – 101C, Level 1	1:00pm-2:50pm
CIST Breakfast/Welcome	C – Seasons, Level 2	7:30am-8:15am
CIST Conference	C – 102A & 102B, Level1	8:15am-5:45pm
CIST Lunch/Speaker	C – Seasons, Level 2	12:15pm-1:45pm
ISR Editors	C – 101E, Level 1	8:00am-2:00pm
Organization Science Competition	C – 101D, Level 1	8:30am-5:00pm
INFORMS Executive Committee	HI – Imperial Suite 2420	8:30am-12:00pm
Vendor Workshops - Session I		
Maximal Software	C – M100F, Mezz.	9:00am-11:30am
McGraw Hill	C – M100A, Mezz.	9:00am-11:30am
SAS Global Academic	C – M100E, Mezz.	9:00am-11:30am
Vendor Workshops - Session II		
AIMMS	C – M100A, Mezz.	12:00pm-2:30pm
American Optimal Decisions	C – M100B, Mezz.	12:00pm-2:30pm
AnyLogic North America	C – M100C, Mezz.	12:00pm-2:30pm
Gurobi Optimization	C – M100D, Mezz.	12:00pm-2:30pm
JMP Software from SAS	C – M100E, Mezz.	12:00pm-2:30pm
MOSEK	C – M100G, Mezz.	12:00pm-2:30pm
Palisade Corp.	C – M100H, Mezz.	12:00pm-2:30pm
INFORMS Board Meeting	HI – Marquette 5-6, Fl.2	12:00pm-5:00pm
Vendor Workshops – Session III		
FICO	C – M100A, Mezz.	3:00pm-5:00pm
Frontline Systems	C – M100C, Mezz.	3:00pm-5:00pm
GAMS Development Corp.	C – M100D, Mezz.	3:00pm-5:00pm
IBM	C – M100E, Mezz.	3:00pm-5:00pm
SAS	C – M100G, Mezz.	3:00pm-5:00pm
INFORMS Membership Meeting/Reception	C – 101G-H, Level 1	5:00pm-6:00pm
INFORMS Roundtable		
Reception	HI – Gallery, Lobby	5:30pm-6:15pm
Meeting	HI – Gallery, Lobby	6:15pm-7:30pm
Dinner	HI – Conrad A, Fl.2	7:30pm-9:00pm
University of Texas at Dallas Reception	C – 101F, Level 1	6:00pm-9:00pm
ISS Awards & ISR Editors Reception	C – 101E, Level 1	6:30pm-8:00pm

KEY
C - Convention Center
HI - Hilton
HY - Hyatt

Where to go for Lunch

CONVENTION CENTER & PROXIMITY

Convention Center Concessions
Portable Concessions - Inside Exhibit Hall D
Sunday-Tuesday, 11:30am-2:00pm
Wonderful made-to-order sub-style sandwiches and burritos, assorted beverages.

Permanent Concession - Outside Exhibit Hall D
Sunday-Tuesday, 9:00am-5:00pm
Breakfast items, hamburgers, chicken sandwiches, coffee, drinks.

Dunn Brothers Coffee Shop - Lobby, Level 1
Daily, 7:00am-5:00pm
Fresh baked goods, sandwiches, drinks.

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(Connected to Convention Center)
Prairie Kitchen and Bar

WALK-TO DINING (WITHIN 2 BLOCKS)

Hilton Minneapolis
Skywater Cuisine & Cocktails (American)
1001 Marquette Ave.

Millennium Hotel
North 45 (American)
1313 Nicollet Mall

Hilton Garden Inn
Great American Grill (American/Vegetarian)
1101 4th Avenue South

Market Bar-B-Que
1414 Nicollet Ave. South

Ping's Szechuan (Asian)
1401 Nicollet Ave. South

Salsa a la Salsa (Mexican)
1420 Nicollet Avenue

Sunday, October 6

INFORMS Roundtable		
Breakfast	HI – Red Wing, Fl.3	7:00am-8:00am
Meeting	HI – Gallery, Lobby	8:00am-4:30pm
Lunch	HI – Red Wing, Fl.3	11:45am-12:30pm
Roundtable/INFORMS Board	HI – Gallery, Lobby	4:30pm-5:30pm
President's Reception Roundtable	HI – Grand E, Fl.3	5:30pm-6:30pm
New Member Breakfast	C – Seasons, Level 2	7:00am-8:00am
ISR Dept. Editors Breakfast	HI – Directors Row 2, Fl.3	7:30am-8:30am
Career Center Breakfast & Meeting	HI – Grand C, Fl.3	7:30am-9:00am
INFORMS Board	HI – Marquette 5-6, Fl.2	8:00am-3:30pm
CIST Breakfast	C – Lounge A, Level 2	7:30am-8:15am
CIST Lunch & Awards	C – Seasons, Level 2	12:15pm-2:00pm
CIST Conference	C – 102A & 102B, Level 1	8:15am-5:15pm
Plenary: Pavel Kabát	C – Ballroom A, Level 1	10:00am-10:50am
CIEADH	HI – Grand G, Fl.3	10:00am-5:45pm
Junior Faculty Interest Group Lunch	HI – Grand A, Fl.3	12:30pm-1:30pm
Service Science Editors	HI – Boardroom 3, Fl.3	12:30pm-1:30pm
ITOR Editorial Lunch	HI – Boardroom 2, Fl.3	12:30pm-1:30pm
M&SOM Associate Editors	HI – Grand B, Fl.3	12:30pm-2:30pm
Plenary: Anne G. Robinson	C – Ballroom A, Level 1	3:10pm-4:00pm
IOL & Social Networking Reception	HI – Rochester, Fl.3	6:00pm-7:00pm
Interfaces Editorial Board	HI – Directors Row 2, Fl.3	6:15pm-7:15pm
Welcome Reception-Exhibits Open	C – Exhibit Hall D	7:30pm-9:00pm
Minority Issues Forum Reception	HI – Grand A, Fl.3	8:00pm-9:00pm
Awards Ceremony & Dessert Reception	C – Ballroom A, Level 1	8:30pm-9:45pm
Reception open to ceremony attendees only, doors close at 8:45pm.		

Monday, October 7

Board/Editors/Committee Chair Breakfast	HI – Grand B, Fl.3	7:00am-8:00am
ITE Editors & Editorial Board	HI – Boardroom 1, Fl.3	7:00am-8:00am
ACORD Breakfast & Meeting	HI – Marquette 4, Fl.2	7:30am-9:00am
Chapters/Fora Committee	HI – Boardroom 2, Fl.3	8:30am-9:30am
Section/Societies Committee	HI – Boardroom 2, Fl.3	9:30am-10:30am
Decision Analysis Editors	HI – Rochester, Fl.3	9:30am-11:00am
Plenary-Omega Rho: Lawrence M. Wein	C – Ballroom A, Level 1	10:00am-10:50am
Omega Rho Committee Meeting	HI – Marquette 5, Fl.2	11:00am-12:30pm
Omega Rho Open Meeting/Lunch	HI – Marquette 5, Fl.2	12:30pm-1:30pm
Sections/Societies Officers Lunch	HI – Grand F, Fl.3	12:00pm-1:30pm
Bonder Scholarship Lunch	HI – Grand A, Fl.3	12:30pm-1:30pm
COIN-OR Members & Users	C – 102D, Level 1	12:30pm-1:30pm
Publications/Editors in Chief	HI – Grand G, Fl.3	12:30pm-3:30pm
Service Science PhD Colloquium	C – 205B, Level 2	12:30pm-1:30pm
SPPSN Lunch	C – Seasons, Level 2	12:30pm-1:30pm
INFORMS Fellows Lunch	HI – Grand C, Fl.3	12:45pm-2:30pm
Subdivisions Council	HI – Duluth, Fl.3	2:30pm-4:30pm
Keynote: 2013 Edelman Reprise	C – Auditorium 2, Level 1	3:10pm-4:00pm
Keynote: Mark von Oven	C – Auditorium 3, Level 1	3:10pm-4:00pm
Texas A&M Reception	HI – Grand B, Fl.3	6:00pm-7:00pm
Carnegie Mellon-Tepper School Reception	HI – Rochester, Fl.3	6:00pm-8:00pm
CPMS Isolated Practitioners Workshop	C – 201A, Level 2	6:15pm-7:15pm
University of Minnesota Reception	HI – Marquette 5, Fl.2	6:15pm-8:15pm
Northwestern University Reception	HI – Grand A, Fl.3	7:00pm-9:00pm

University of Michigan Reception	HI – Grand E, Fl.3	7:00pm-9:00pm
University of Texas at Austin Reception Honoring Leon Lasdon	HI – Grand F, Fl.3	7:00pm-9:00pm
Cornell University Reception	HI – Boardroom 3, Fl.3	7:15pm-9:15pm
MOR Associate Editors	Newsroom Restaurant 990 Nicolet Mall	7:30pm-9:30pm
Wharton Alumni Reception	HI – Red Wing	7:30pm-9:30pm
Student Awards Ceremony	HI – Grand D, Fl.3	7:30pm-8:00pm
Student Reception	HI – Grand D, Fl.3	8:00pm-9:30pm

tuesday, october 8

Saul Gass Memorial Fun Run	Loring Park, Nicollet Mall across street from Hyatt entrance	6:30am-8:00am
Chapters/Fora Officers Breakfast	HI – Grand A, Fl.3	7:00am-8:00am
Transportation Science Associate Editors	HI – Boardroom 3, Fl.3	7:30am-9:00am
Korea Chapter Breakfast	HI – Marquette 4, Fl.2	7:30am-9:00am
DAS Strategic Planning	C – 102B, Level 2	7:30am-9:30am
Student Chapter Officers	HI – Grand A, Fl.3	8:00am-8:45am
Meetings Committee	HY – Suite 2425	8:30am-5:00pm
Plenary: Dimitris Bertsimas	C – Ballroom A, Level 1	10:00am-10:50am
JOC Editorial Board	HI – Rochester, Fl.3	12:30pm-1:30pm
International Activities Committee Lunch	HI – Boardroom 2, Fl.3	12:30pm-1:30pm
Women in OR/MS Lunch	C – Seasons, Level 2	12:30pm-1:30pm
Keynote: 2013 Wagner Prize Winner	C – Auditorium 2, Level 1	3:10pm-4:00pm
Keynote: Pascal Van Hentenryck	C – Auditorium 3, Level 1	3:10pm-4:00pm
Future Organizing Committee Reception	C – 102A-C, Level 1	5:00pm-6:00pm
Certified Analytics Professional Reception	C – 200I, Level 2	6:15pm-7:15pm
General Reception	C – Exhibit Hall A	7:30pm-10:00pm

wednesday, october 9

Keynote: UPS George D. Smith Reprise	C – Auditorium 2, Level 1	10:00am-10:50am
Keynote: Guillermo Gallego	C – Auditorium 3, Level 1	10:00am-10:50am
Analytics Certification Board	HI – Boardroom 3, Fl.3	12:00pm-6:00pm

informs career center

INFORMS Career Center (ICC) is the largest source of operations research and analytics jobs and resumes. It's where job seekers go to land the right job in academia or industry and where employers post their jobs and search our resume database for qualified candidates.

Job Fair
Sunday
12:00pm-5:00pm
Convention Center - Exhibit Hall D

The Job Fair provides an opportunity for job seekers to meet participating employers in an informal atmosphere and to discuss employment opportunities within those organizations. Employers meet and collect resumes from many job seekers in a short period of time early in the meeting, giving them the chance to set up interviews during the meeting.

ICC On-Site Interviews
Monday-Tuesday, 9:00am-5:00pm
Wednesday, 9:00am-3:00pm
Convention Center - Exhibit Hall D

This service provides employers and applicants with a convenient venue for on-site interviews to explore opportunities in academia, industry and government. In addition, the job placement service offers:
- Online access to job listings and applicant files,
- Expanded information about jobs and applicants,
- Weekly updates of the database,
- Improved database search capabilities,
- Online data entry for applicants and employers,
- Extended availability of the database.

http://careercenter.informs.org

Panel Discussions
Select panels will lead informal discussions about the industry and academic interview processes.

The Academic Job Search
Monday, 11:00am-12:30pm (MB44)
Center – 101D, Level 1

The Industry Job Search
Monday, 1:30pm-3:00pm (MC44)
Center – 101D, Level 1

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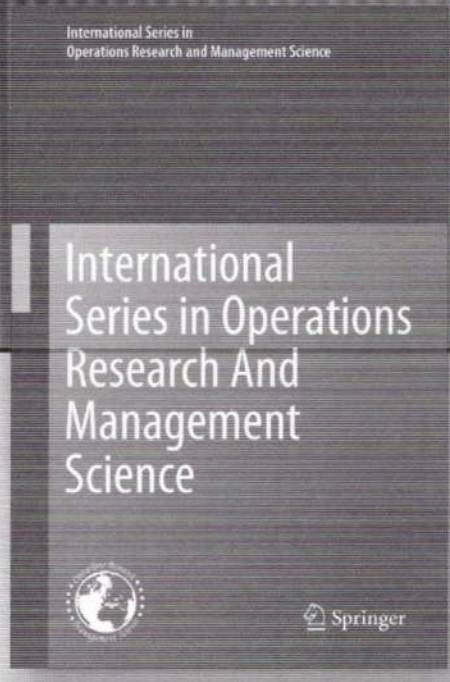
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SPECIAL EVENT
IN HONOR OF FRED HILLIER

Springer cordially invites you to a special event in honor of Fred Hillier on the occasion of his retirement after 20 years as Founding Series Editor to the International Series in OR & MS.



Please join us to congratulate Fred on his many accomplishments in the field and in the series, as well as to meet our new Series Editor Camille C. Price.



WHERE:

Director's Row 2 at the Hilton Minneapolis
1001 Marquette Ave. South
Minneapolis, MN, 55403

WHEN:

Monday, October 7, 2013, 6:00-7:30pm

Business, Receptions and Networking...All Welcome!

KEY
C - Convention Center
H - Hilton

SUNDAY, October 6

Information Systems	C –102A, Level 1	5:30pm-6:30pm
Aviation Applications	C – M101A, Mezz.	6:15pm-7:15pm
Data Mining & Artificial Intelligence	C – M100A, Mezz	6:15pm-7:30pm
Decision Analysis Council	C – M101B, Mezz.	6:15pm-7:30pm
Energy, Natural Resources & Environment	C – 103F, Level 1	6:15pm-7:15pm
Forum on Education (INFORM-ED)	C – 211A, Level 2	6:15pm-7:15pm
Location Analysis	C – 208D, Level 2	6:15pm-7:15pm
Manufacturing & Service Ops. Mgt.	C – 101FG, Level 1	6:15pm-7:15pm
Military Applications Board	C – 209A, Level 2	6:15pm-7:15pm
Minority Issues Forum	C – 206, Level 2	6:15pm-7:15pm
Multiple Criteria Decision Making	C – 213B, Level 2	6:15pm-7:15pm
Optimization	C – 200E, Level 2	6:15pm-7:15pm
Railway Applications	C – 211C, Level 2	6:15pm-7:15pm
Revenue Management & Pricing	C – 208A, Level 2	6:15pm-7:15pm
Simulation	C – 211D, Level 2	6:15pm-7:15pm
Spreadsheet Productivity Research	C – 207, Level 2	6:15pm-7:15pm
Telecommunications	C – 201A, Level 2	6:15pm-7:15pm
Transportation Science & Logistics Board	C – 102E, Level 1	6:15pm-7:15pm
Revenue Management & Pricing Board	C – 208B, Level 2	7:15pm-8:15pm

MONDAY, October 7

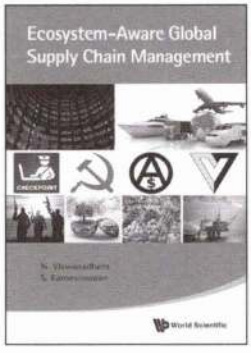
Public Programs, Services & Needs	C – Seasons, Level 2	12:30pm-1:30pm
Analytics Section	C – 200I, Level 2	6:15pm-7:15pm
Applied Probability	C – 205C, Level 2	6:15pm-7:15pm
Computing	C – 200H, Level 2	6:15pm-7:15pm
Decision Analysis	C – M100H, Mezz.	6:15pm-7:15pm
eBusiness	C – 212A, Level 2	6:15pm-7:15pm
Financial Services	C – 200C, Level 2	6:15pm-7:15pm
Health Applications	C – 204, Level 2	6:15pm-7:15pm
Military Applications	C – 208C, Level 2	6:15pm-7:15pm
Quality, Statistics & Reliability	C – M100D, Mezz.	6:15pm-7:15pm
Social Media Analysis	C – M100F, Mezz.	6:15pm-7:15pm
Technology Management	C – 211B, Level 2	6:15pm-7:15pm
Transportation Science & Logistics	C – Ballroom A, Level 1	6:15pm-7:15pm
Women in OR/MS	C – 200D, Level 2	6:15pm-7:15pm
Behavioral Operations Management	C – 200E, Level 2	7:15pm-8:15pm
Military Applications Reception	C – 208D, Level 2	7:15pm-10:15pm

TUESDAY, October 8

CPMS Council	H – Marquette 5, Fl.2	7:00am-9:00am
SpORts	C – 204, Level 2	6:00pm-7:00pm
Service Science	C – 203, Level 2	6:15pm-7:15pm

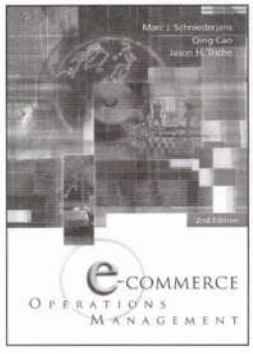
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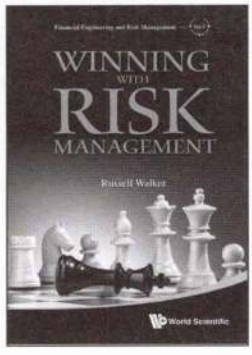
Jul 2013 • 9789814508162 (HC) • US$85 / £56

by **N Viswanadham**
(Indian Institute of Science, India) & **S Kameshwaran**
(IBM Research, India)



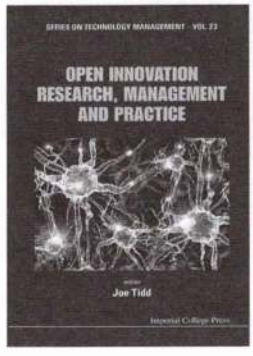
Nov 2013 • 9789814518635 (SC) • US$34 / £22
9789814518628 (HC) • US$68 / £45

by **Marc J Schniederjans**
(University of NebraskaLincoln, USA) et al.



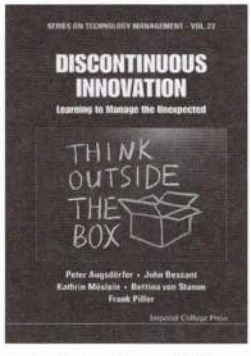
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(Northwestern University, USA)



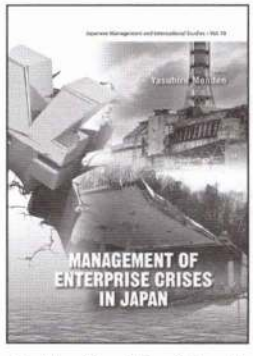
Feb 2014 • 9781783262809 (HC) • US$88 / £58

edited by **Joe Tidd**
(SPRU, University of Sussex, UK)



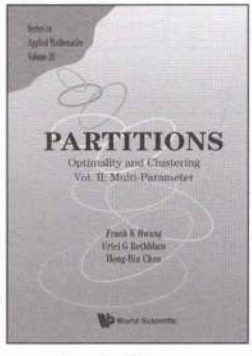
Oct 2013 • 9781848167803 (HC) • US$78 / £51

by **Peter Augsdörfer**
(Technische Hochschule Ingolstadt, Germany) et al.



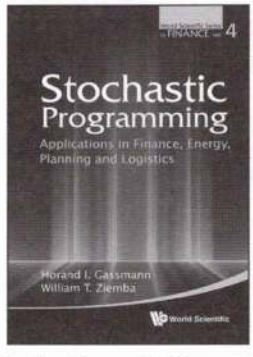
Nov 2013 • 9789814508506 (HC) • US$78 / £51

edited by **Yasuhiro Monden**
(University of Tsukuba, Japan & University of Nagoya, Japan)



Jun 2013 • 9789814412346 (HC) • US$99 / £65

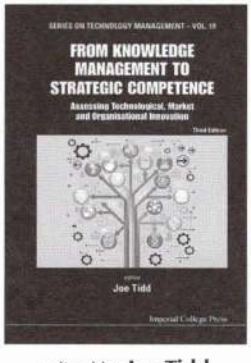
by **Frank K Hwang**
(National Chiao-Tung University, Taiwan) et al.



Jan 2013 • 9789814407502 (HC) • US$90 / £59

edited by **Horand I Gassmann**
(Dalhousie University, Canada) et al.

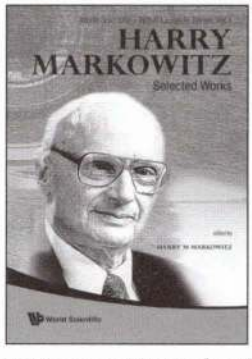
:: Bestseller



Apr 2012 • 9781848168831(HC) • US$120 / £79
9781848168848(SC) • US$64 / £42

edited by **Joe Tidd**
(University of Sussex, UK)

:: Bestseller

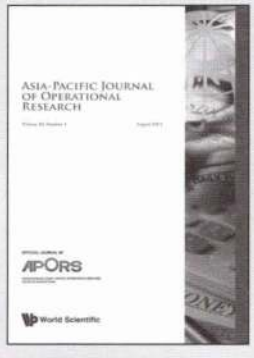


Mar 2009 • 9789812833631 (HC) • US$182 / £120

edited by **Harry M Markowitz**
(University of California, San Diego, USA)

Nobel Laureate in Economics, 1990

JOURNALS



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mobile app

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In collaboration with Wiley, INFORMS is pleased to offer a free web-based mobile app. Use the app to access conference info on the go, including the schedule of sessions and presentations, plenary/keynote speaker information, maps, exhibitor details, links to Wiley and INFORMS journals, and much more.

How to Access

Download the app and follow instructions on the opening screen. You will need Internet access to download and to update. However, once the app has been loaded on your device, you can access most of its features even when you don't have an Internet connection (except for links to websites). If your device prompts you to connect to the Internet when opening the app and no connection is available, you can safely ignore it and continue to use the app. When you have wireless access again, the app will update automatically.

How to Use

- Build your personal itinerary – Plan your day by selecting talks from the program schedule. You can also add custom personal events such as appointments with colleagues and exhibitors.
- Engage and network –You can edit your own profile or add information, such as your email address, to facilitate networking. The app also has quick links to conversations about the conference on Twitter, Facebook, LinkedIn and others.
- Find what you're looking for fast – Use the search capability and interactive maps to find sessions and exhibitors more easily.
- Take notes – Take notes about sessions, speakers and exhibitors. At the end of the event, you can easily export all notes via email.
- Access must-have research – You can quickly access articles from Wiley publications, as well as informative RSS feeds from several INFORMS journals and magazines.

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Blogs

Check out the Minneapolis 2013 web page for posts from our talented group of bloggers during and after the meeting:

Lars Beckmann
Allen Butler
Sertalp Çay
Marc-André Carle
Kenneth Chelst
Jim Cochran
Walt DeGrange
Mike Gorman
Warren Hearnes
S. Phil Kim
Bjarni Kristjansson
Jennifer Leong
Patrick Noonan
John Poppelaars
Guillaume Roels
Paul Rubin
Matthew Saltzman
Dawn Strickland
Shivaram Subramanian
Michael Trick
Tallys Yunes

All attendees are welcome to blog. For instructions, email Shirley.Mohr@informs.org or drop by the INFORMS booth in Exhibit Hall D.

Join the Twitter Conversation

Add the hashtag #informs2013 to your tweets to associate them with the meeting. Tweets with #informs2013 will be displayed in the Attendee Twitter Feed on the homepage, along with official conference tweets that will alert you to late-breaking information. If you haven't become a Twitter-ite but would like an introduction, stop by the INFORMS booth for a quick lesson.

Facebook

RSVP for the Annual Meeting and see which of your colleagues are attending. Go to our Facebook page and click through events to the Annual Meeting page.

LinkedIn

Connect with other attendees on the Annual Meeting LinkedIn Group to discuss key topics. Go to the Annual Meeting website homepage to find a link leading to the Annual Meeting LinkedIn group.

Pinterest

Visit our Pinterest Annual Meeting Board to view a collection of fun things to do and see while visiting Minneapolis. http://pinterest.com/informs/2013-informs-annual-meeting-minneapolis/

Share Your Conference Photos

Attendees are encouraged to take photos and video at the meeting; send your photos to photosandvideo@mail.informs.org so we can post them in our Flickr album and on the meeting blog.

eNews Daily

INFORMS is publishing the sixth volume of its popular Annual Meeting eNews Daily in Minneapolis. This official record of the Annual Meeting is delivered each day to your in-box, providing a recap of the previous day's happenings and a preview of the upcoming day's can't-miss events. There are links to each issue on the Annual Meeting website. If you would like to advertise in eNews Daily, visit the sponsor page on the Annual Meeting website.

Podcasts

Liven up your travel to and from the INFORMS Annual Meeting by bringing along an INFORMS podcast for the road. Download a podcast at www.scienceofbetter.org/podcast.

informs tv

Tune in to INFORMS TV during the meeting to catch the latest conference highlights, enjoy "behind the scenes" interviews with meeting speakers and INFORMS leaders, and hear reactions and interviews with attendees like you. Each day's broadcast will combine coverage of conference events with "thought leadership" segments that feature various organizations. The overall goal of INFORMS TV is to raise the visibility of best practices in operations research and management sciences, as well as to highlight collaborations between diverse institutions including research institutions, universities, and private sector organizations. Programs from these organizations will be featured in the broadcasts:

- Lancaster University, UK
- CIRRELT, Canada
- Center for Disease Control, USA

Where and when to tune in:

- Check out the video displays around the conference venue including the foyer outside Exhibit Hall D.
- If you are staying at the Hilton or Hyatt, you can see a new program each day on the TV in your room
- The team from WebsEdge Production will begin filming on Sunday. The first broadcast will be aired at the Hilton and Hyatt on Sunday evening, and then continue all day Monday. The Monday coverage will air on Tuesday, and the Tuesday coverage will air on Wednesday.

Speaker Guidelines

Audio/Visual Equipment

All session rooms will be equipped with a computer projector, but please note that you must provide your own laptop or pre-arrange to share with others in your session. Please follow these guidelines to ensure a successful presentation:

- Bring your laptop to your session. We recommend that you pre-arrange with other speakers in your session to ensure that at least one of you brings a laptop from which you can project your talks.
- Bring a power adaptor with you. We recommend that you do not attempt to run your presentation off the laptop battery.
- If your laptop is not compatible with AC power, please bring an electrical adaptor so that you can connect to U.S. electricity.
- If your laptop is an Apple product, you will need the appropriate adapter for the external video output.
- Arrive at your session at least 15 minutes before it begins. All presenters in a session should set up and test the connection to the projector before the session begins.
- We encourage speakers to put their presentations on a USB flash drive as a backup.

Speaker Ready Room

There will be a Speaker Ready Room available in the Convention Center, Exhibit Hall D, during the meeting. You can stop by and practice connecting your laptop to the projector. Technical assistance will be available during your session if you encounter any problems.

Presentation Guidelines

The room and location of your session are listed in the Technical Sessions section and in the Master Track Schedule. Please be on time for your session and check in with the session chair. Presentations should be limited to key issues with a brief summary. Time your presentation to fit within your designated time span and leave an opportunity for questions and audience participation. INFORMS does not produce proceedings with complete papers. To obtain complete copies of any papers abstracted in the program, please contact the authors directly at the addresses supplied with each abstract.

For Questions about the Program: Program Information Desk

If you have general questions about the meeting and/or questions about your own presentation, stop by the Program Information Desk located in the Convention Center, near INFORMS Registration in Exhibit Hall. We ask Session Chairs to notify the Information Desk about any last-minute changes or cancellations; these changes will be posted outside the meeting rooms.

For Assistance during Your Session: Session Monitor Desks

Session Monitor Desks are located in several areas in the Convention Center (see maps on pages 42-44 for specific locations). If you have a problem in your session room related to AV needs or any other requests, go to the Session Monitor Desk in the area to ask for assistance.

Courtesy to Fellow Speakers

Attendees are asked to be respectful of their colleagues by turning off cell phones and mobile devices before the presentations begin. In addition, please note that use of cameras and all recording devices is prohibited during sessions unless you have received prior permission from the speaker.

Session Chair Guidelines

The role of the Chair is to coordinate the smooth running of the session. The Chair:

- Begins and ends the session on time. Each session lasts 90 minutes, with the time per presentation determined by the number of papers in the session. Equal time should be given to each paper.
- Introduces each presentation (just the title of the paper and the name of the presenting author).
- Ensures that presentations are made in the order shown in the program. This allows for "session jumping." If a speaker cancels or does not attend, the original time schedule should be adhered to rather than sliding every talk forward.
- Completes the session attendance forms (forms will be in the room).
- Reminds the audience to (a) turn off all mobile devices and (b) that photography is not allowed without the prior permission of the speaker.

Thank You

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AIMMS

Exhibits

Name badges must be worn for admittance to the Exhibit Hall, located in the Convention Center, Exhibit Hall D, during the following hours:

Sunday, Oct. 6	12:00pm-5:00pm 7:30pm-9:00pm* (Welcome Reception)
Monday, Oct. 7	9:00am-5:00pm
Tuesday, Oct. 8	9:00am-5:00pm
Wednesday, Oct. 9	9:00am-1:00pm

*The Exhibit Hall is open Sunday evening for a gala Welcome Reception. All registrants are invited to the reception for the chance to meet colleagues and renew acquaintances.

Technology Center

Free Wireless

Free wireless Internet and a technology center are located in Exhibit Hall D in the Convention Center. There are a limited number of computers available in the Technology Center if you do not have your own computer. Name badges must be worn for admittance. The Center will be open during the following hours:

Sunday, Oct. 6	12:00pm-5:00pm
Monday, Oct. 7	7:00am-5:00pm
Tuesday, Oct. 8	7:00am-5:00pm
Wednesday, Oct. 9	7:00am-1:00pm

In addition, there is free wireless in the first floor public areas when the Exhibit Hall is not open.

Business Centers

The business center is located across from Room 101A, Level 1. Hours of operation are are Monday-Friday, 9:00am-5:00pm; Saturday-Sunday, 9:00am-4:00pm.

Registration

Badges Required for Technical Sessions
INFORMS Annual Meeting 2013 badges must be worn to all sessions and events. Badges will be checked at the entrance to technical session areas, as well as the Exhibit Hall. Attendees without badges will be directed to the INFORMS registration desk to register and pick up their badges. All attendees, including speakers and session chairs, must register and pay the registration fee. **Lost badges can be replaced at the registration desk for a fee of $5.**

Registration Fee
Your registration fee includes admittance to the complete technical program, the Exhibit Hall, Technology Center and most special programs. The following social/food events are also included: Sunday evening Welcome Reception and Awards Ceremony, Tuesday evening General Reception, and all morning and afternoon coffee breaks. No other meals are included.

Guest Registration
If your guest would like to accompany you to the major social events, you can purchase a guest registration ($75) that covers admission to the Sunday Welcome Reception, Sunday Awards Ceremony and Tuesday General Reception. Guests are not eligible to attend the technical sessions. Go to the Registration Desk to register your guest.

25+ Year Member Ribbon
If you have been an ORSA-TIMS-INFORMS member for 25 or more years, please stop by the INFORMS booths (#55-57 in the Exhibit Hall) to pick up a special ribbon designating your 25+ year membership. We salute our long-time members!

Other Services

Luggage Check
A luggage check area will be located in the Convention Center, Exhibit Hall D. The luggage check will be open on Tuesday, 7:00am-6:30pm and Wednesday, 7:00am-6:00pm.

Minneapolis Visitor Information
A Visitor Information Center is located in the main lobby (behind the spiral staircase), every day, 8:00am-4:30pm, and can assist with directions. In addition, the Minneapolis Convention and Visitor's Bureau will have an information desk inside Exhibit Hall D, Saturday-Tuesday, 11:00am-5:00pm. You can stop by to learn about Minneapolis, its museums, shopping, attractions, nightlife and much more. Trained, professional restaurant information specialists can assist with sample menus and make dinner reservations, and provide you with an acknowledgement to present to the restaurant for special convention attention!

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New! Especially for Students

Coffee with a Member
This new pilot program connects INFORMS students with some of INFORMS most enthusiastic "regular" members for 15-minute impromptu meetings and some sage INFORMS advice. We know the Annual Meeting can be a bit overwhelming and are hoping these casual meetings will make students more comfortable, knowledgeable, and enthusiastic about both the meeting and INFORMS. Student attendees were offered the opportunity to sign up before the meeting on a first-come, first-served basis (it is not possible to sign up onsite in Minneapolis). We will follow up after the meeting with a short survey to the students and regular members who participated to judge the effectiveness of the program.

Student Networking Lounge
Relax and network with other students in the INFORMS Student Lounge. We've created this space in Exhibit Hall D, so that you can take this opportunity to introduce yourself to other students, share your conference experiences, talk about the sessions you've attended, and surf the net.

Follow @INFORMS2013 to keep an eye out for special pop-up Student Lounge happenings.

Saturday, October 5

INFORMS Membership Meeting & Reception
5:00pm-6:00pm
Center - 101G-H, Level 1
The INFORMS Board of Directors encourages all members to bring their ideas, opinions and suggestions to this annual meeting. Current business and future directions for INFORMS are on the agenda. Wine and cheese will be served.

Sunday, October 6

New Member Welcome Breakfast
7:00am-8:00am
Center - Seasons, Level 2
By Invitation – Ticket Required
New INFORMS members received a ticket for this welcome breakfast in their registration packets. The session will feature a presentation on member benefits, a brief orientation to navigating the meeting, and a chance to relax and connect with colleagues. Representatives from INFORMS communities will facilitate networking tables where you can meet other members who share your professional interests.

Junior Faculty Interest Group Luncheon
12:30pm-1:30pm
Hilton - Grand A, 3rd Fl.
$25 ($15 students) - A limited number of tickets may be available on-site. Go to the INFORMS registration desk for information on availability. No tickets will be sold at the door.
The winners of the 2013 JFIG Paper Competition will be presented with awards. All junior faculty are invited to participate. This event gives junior faculty in engineering and business schools the opportunity to discuss career development and exchange ideas.
Sponsored by INSEAD; University of Florida; Texas A&M University, Dept. of Industrial & Systems Engineering; and Wichita State University.

INFORMS Online & Social Networking Reception
6:00pm-7:00pm
Hilton - Rochester, 3rd Fl.
What's your social networking strategy for yourself or for INFORMS? We invite all contributors to IOL (the INFORMS website) and INFORMS social networking sites to come and meet face to face. Join us for refreshments and drinks - we are your INFORMS Online community!

Minority Issues Forum Reception
8:00pm-9:00pm
Hilton - Grand A, 3rd Fl.
Come meet old friends and make new ones while talking about minority issues and other intellectual issues and opportunities. Posters submitted to the Minority Issues Forum Poster Competition will be on display during the reception.
Sponsored by North Carolina State University, Edward P. Fitts Dept. of Industrial & Systems Engineering; University of Arkansas, Dept. of Industrial Engineering; Cornell University, School of Operations Research and Information Engineering; University of Michigan, Dept. of Industrial and Systems Engineering; and Clemson University, Dept. of Industrial Engineering.

Monday, October 7

COIN-OR Members & Users Meeting Bag Lunch
12:30pm-1:30pm
Center - 102D, Level 1
Anyone interested in open-source software tools, open standards, and data and model repositories for any aspect of operations research is encouraged to attend this Computational Infrastructure for OR (COIN-OR) meeting. Please bring your own lunch and ideas. For more information, visit www.coin-or.org.

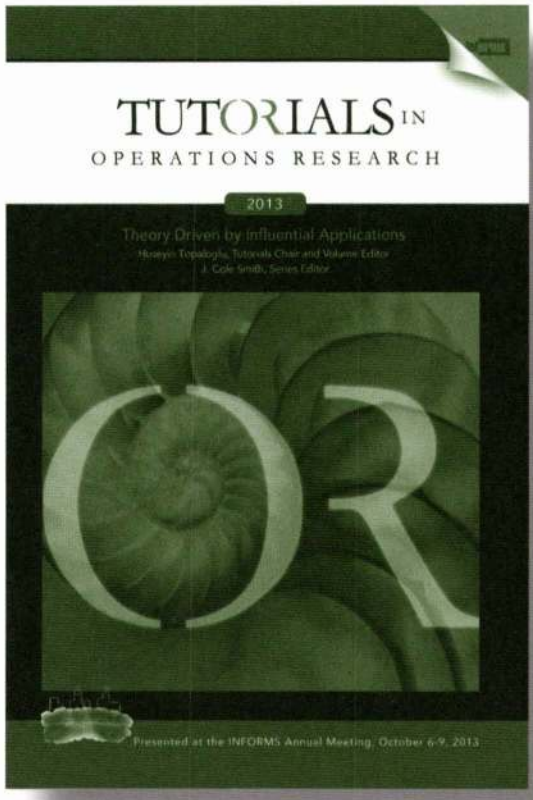
SPPSN Lunch
12:30pm-1:30pm
Center - Seasons, Level 2
$15 - Section member ($20 nonmember) - *A limited number of tickets may be available on-site. Go to the INFORMS registration desk for information on availability. No tickets will be sold at the door.*
This lunch and business meeting is open to members of the INFORMS Section on Public Programs, Service and Needs and also those who are interested in joining the section.
Sponsored by Georgia Institute of Technology, Dept. of Industrial & Systems Engineering; Kansas State University, Dept. of Industrial & Manufacturing Systems Engineering; and University of Michigan, Dept. of Industrial & Operations Engineering.

FREE ACCESS!
2013 TutORials are now available ONLINE for all INFORMS Annual Meeting attendees!

TUTORIALS IN OPERATIONS RESEARCH

NOW AVAILABLE!

Theory Driven by Influential Applications
Huseyin Topaloglu, volume editor
J. Cole Smith, series editor



INFORMS 2013 edition of the *TutORials in Operations Research* series will be available online to all 2013 INFORMS Annual Meeting registrants on October 1, 2013 as part of their meeting registration. All INFORMS 2014 members will be able to access all the 2013 *TutORials* content in its entirety starting January 1, 2014.

TutORials in Operations Research is a collection of tutorials published annually and designed for students, faculty, and practitioners. The series provides in-depth instruction on significant operations research specialties and practices. Use the searchable content for classrooms, boardrooms, and personal use on your desktop.

The 2013 *TutORials* volume covers a broad range of applications and methodologies within operations research. *Theory Driven by Influential Applications* contains 11 tutorial chapters focusing on recent developments and current issues facing operations researchers, professionals, and academics. This is a valuable reference and educational tool for today's O.R. professional.

SPECIAL OFFER:
Visit INFORMS booth #51-53 to purchase the 2013 book for only $30! Post-Conference Price $45.

Limited supplies of these books or CDs are still available:



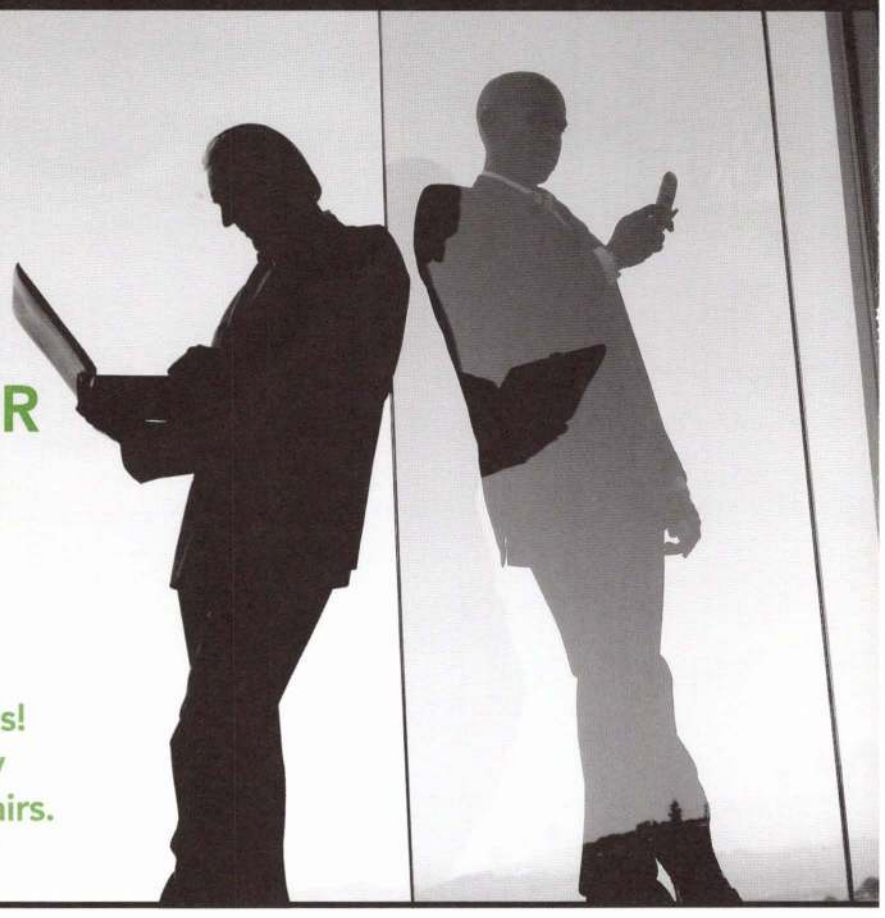
2005 2006 2007 2008 2009 2010 2011 2012

Order the 2005-2013 *TutORials in Operations Research* Books & CDs

http://tutorials.pubs.informs.org

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NEW INFORMS Career Center



INFORMS CAREER CENTER

YOUR NEXT O.R./ ANALYTICS CAREER MATCH COULD BE CLOSER THAN YOU THINK.

Attend the Job Fair in Minneapolis! INFORMS provides industry's only in-person O.R. and analytics job fairs.

October 6-9, 2013

Job Seeker Benefits

- Access to high quality, relevant job postings. No more wading through postings that aren't applicable to your expertise.
- Personalized job alerts notify you of relevant job opportunities.
- Career management – you have complete control over your passive or active job search. Upload multiple resumes and cover letters, add notes on employers and communicate anonymously with employers.
- Anonymous resume bank protects your confidential information. Your resume will be displayed for employers to view EXCEPT your identity and contact information which will remain confidential until you are ready to reveal it.
- Value-added benefits of career coaching, resume services, education/training, articles and advice, resume critique, resume writing and career assessment test services.

Employer Benefits

- Access highly-qualified, professional candidates.
- Generate high return on recruitment advertisement spending.
- Access to the highly coveted passive job seeker.
- Easy-to-use job posting and resume searching capabilities.
- Access to job board networks for broader job distribution to qualified candidates.
- Only pay for resumes of interested candidates.
- Applicant tracking and management capabilities.
- Internal messaging system automatically stores messages sent from the job seeker in the candidate's file.
- User-friendly template system to reuse job postings, pre-screen filters and automatic letters and notifications.

http://careercenter.informs.org

POWERED BY JOBTARGET

CPMS Isolated Practitioner Workshop & Reception
6:15pm-7:15pm
Center - 201A, Level 2
CPMS, The Practice Section of INFORMS, sponsors this workshop on topics of interest to isolated practitioners, the "Lone Rangers" of OR/MS. This workshop will address timely issues that affect isolated practitioners. All are welcome to participate. Wine and cheese will be served.

Student Awards Ceremony & Reception
Awards Ceremony: 7:30pm-8:00pm
Reception: 8:00pm-9:30pm
Hilton - Grand D, 3rd Fl.
All students registered for the meeting are invited to attend the Student Awards Ceremony. The Chapters/Fora Committee will present the winners of the Student Chapter Annual Awards and the Judith Liebman Awards. Join us to recognize the great contributions of our most dynamic student volunteers. Plan to stay for the Student Reception, which immediately follows the ceremony.

The reception that follows the Awards Ceremony is open to all students – join us for an evening of food and drink, fun and networking. Come relax after a busy day of sessions and mingle with fellow students from universities around the world.

thank you

THE SETH BONDER FOUNDATION

tuesday, october 6

Saul Gass Memorial Fun Run
6:30am-7:00am: Check-in
7:00am-8:00am: Run
Loring Park, on Nicollet Mall-Across the street from the Hyatt Hotel entrance
$10 (Includes T-shirt!) – You can register at the INFORMS registration desk for the run – deadline to sign up is Monday at 5:00pm.

We're bringing back a great INFORMS event this year and honoring OR luminary Saul Gass at the same time. Saul championed the run at the INFORMS meeting for many years as a laid-back, informal, everybody-included event. This year's run will be in the same tradition. You can walk, jog, stroll, trot or run this 5K course that winds its way through beautiful Loring Park, an oasis of greenery and water right in the heart of the city. The starting point is just across the street from the Hyatt Hotel on Nicollet Mall. The emphasis is on having fun, convening with old and new INFORMS colleagues, and working those muscles in preparation for another packed day of sessions. Ribbons will be awarded to the top three female runners and top three male runners.

Women in OR/MS Forum Luncheon
12:30pm-1:30pm
Center - Seasons, Level 2
$18 ($8 students) – *A limited number of tickets may be available on-site. Go to the INFORMS registration desk for information on availability. No tickets will be sold at the door.*

All those interested in issues related to women professionals in OR/MS are invited to join us.

Sponsored by Georgia Tech, Stewart School of Industrial & Systems Engineering; SAS, Inc.; Texas A&M University, Dept. of Industrial & Systems Engineering; University of Alabama, College of Business; University of Massachusetts, Isenberg School of Business; University of Arizona, Systems & Industrial Engineering; Northwestern University, Dept. of Industrial Engineering & Management Science; Virginia Commonwealth University, Dept. of Statistical Sciences & O.R; SIMUL8 Corporation; University of Texas-Arlington; Penn State University-Erie; University of Texas-Austin, Operations Research & Industrial Engineering; and University of Florida, Dept. of Industrial & Systems Engineering.

guest program

The program for registered guests includes the Sunday Welcome Reception and Awards Ceremony, and the Tuesday evening General Reception. Registered guests will receive a colored name badge that must be worn for admittance to these events. Guests are not eligible to attend the technical sessions. Guest registration is $75 - go to the INFORMS Registration Desk to register your guest.

guest tours

No on-site registration is available for the guest tours. If you have registered in advance, meet in the Convention Center outside of Ballroom A, Level 1. Buses will leave at the beginning time listed for each tour, and will return to the Convention Center at the ending time listed.

Twin Cities Highlights Tour
Sunday, October 6
9:00am-12:00pm

Mall of America
Monday, October 7
10:00am-3:00pm

plant tour

No on-site registration is available for the plant tour. If you have registered in advance, meet in the Convention Center outside of Ballroom A, Level 1. Buses will leave at the beginning time listed and will return to the Convention Center at the ending time listed.

Medtronic Energy and Component Center (MECC)
Monday, October 7
8:45am-11:00am

Your badge is your ticket

Wear your badge for admission to these events; your meeting registration fee includes these special receptions. If your guest would like to accompany you, a guest registration must be purchased (guests will receive a special badge). The $75 guest fee includes the Sunday Welcome Reception, Sunday Awards Ceremony and the Tuesday General Reception.

SUNDAY

Welcome reception & exhibits

7:30pm-9:00pm
Convention Center – Exhibit Hall D

INFORMS and the Minneapolis Organizing Committee welcome you to the 2013 Annual Meeting with an evening of fellowship and fun. The Welcome Reception is the perfect venue to meet with colleagues and visit the exhibits. Light snacks will be served. Soft drinks are complimentary, with a cash bar for other beverages.

INFORMS Awards Ceremony & dessert reception

8:30pm-9:45pm (Doors close at 8:45pm)
Convention Center- Ballroom A

The INFORMS Board of Directors invites you to honor and celebrate the achievements of our colleagues at the annual Awards Ceremony. You can attend the Welcome Reception first and then walk down the foyer to Ballroom A for the Awards Ceremony. Following the ceremony, you'll have an opportunity to congratulate the awardees at a special dessert reception.

Please note that the reception is part of the ceremony event, open to the awardees, their friends and colleagues, and all those who attend the Award Ceremony itself. We are sorry we cannot accommodate guests to the reception who do not also attend the ceremony.

These prestigious awards will be presented during the ceremony:

INFORMS Expository Writing Award
Frank P. Kelly, University of Cambridge

INFORMS President's Award
Arthur M. Geoffrion

Frederick W. Lanchester Award
To Be Announced at Awards Ceremony

INFORMS Prize for the Teaching of ORMS Practice
Alexandra M. Newman, Colorado School of Mines

George E. Kimball Medal
Rina R. Schneur, Verizon Laboratories
Eric Wolman, Retired

John von Neumann Theory Prize
To Be Announced at Awards Ceremony

Bonder Scholarship for Applied Operations Research in Health Services
Pooyan Kazemian, University of Michigan

Bonder Scholarship for Applied Operations Research in Military Applications
Nathanial D. Bastian, The Pennsylvania State University

Four student awards will also be announced during the ceremony: the George E. Nicholson Student Paper Competition, the George B. Dantzig Dissertation Prize, the Doing Good with Good O.R. Student Competition, and the INFORMS Undergraduate Operations Research Prize

thank you

GAMS

TUESDAY

General reception: Winter in the City & Summer Up-North

7:30pm-10:00pm
Convention Center – Exhibit Hall A, Lower Level

Everyone knows there's nothing bland about Minnesota weather! At this year's general reception, you can experience the snows of a Minneapolis winter and the sunshine of a Northwoods summer – all in one fun evening.

Winter in the City features replicas of some Minneapolis icons – like the "Spoonbridge and Cherry" sculpture and the University of Minnesota's new football stadium in Dinkytown. Summer Up-North showcases the log cabins and bait and tackle shops that line the roads in every northern Minnesota town.

Graffiti Wall, Photo Booth & Golf
Don't miss the downtown graffiti wall where you can don an artist's cap and engage in some constructive vandalism – and bring home a photo of your art. We'll have a couple of photo stations as well, complete with hats, mittens and furs for shivering in the city, as well as a fishing pole and plaid shirt for your trip up north.

Step over to the campfire to make s'mores (with as many marshmallows as you can fit on the graham cracker). Play a round of golf at our 9-hole miniature course. And as a bonus – rock the night away to the music of Rockfist, a hot rock 'n roll cover band.

Plus...Fun Food
Of course, we'll be serving up a hearty menu that features some Minnesota favorites: walleye cakes with lemon aioli, State Fair all-beef corn dogs, veggie black bean burger, turkey burger slider, grilled fresh corn on the cob, wild rice and wheatberry salad, camp potatoes, vegetarian baked beans and cole slaw.

You'll have a great time – you betcha!

DM-HI Workshop

INFORMS Workshop on Data Mining and Health Informatics

Space may still be available for this workshop. A separate fee is required - you can inquire at the INFORMS registration desk located in the Convention Center.

Breakfast/Welcome Session

8:00am-8:30am – Center, 101C, Level 1

Workshop

8:30am-6:30pm – Center, 101A & 101B, Level 1

The theme of the workshop centers on health informatics. The Data Mining (DM), Artificial Intelligence (AI) and Health Informatics (HI) sections of INFORMS are jointly organizing this workshop. The DM, AI and HI sections are interdisciplinary communities that bring together researchers and practitioners in science, engineering and business who are interested in the theories, applications and methodologies of DM, AI and HI. This workshop highlights the frontiers of fundamental and applied research in DM, AI and HI.

Vendor Workshops

All Vendor Workshops are located in the Convention Center, Mezzanine Level.

9:00AM - 11:30AM

Maximal Software, Inc.
Deploying Optimization Models on Servers and Mobile Platforms Using MPL OptiMax
M100F

McGraw-Hill Game-Based Learning
Incorporating Game Based Learning into Your Introductory Operations Management Course
M100A

SAS Global Academic Program
SAS Visual Analytics
M100E

12:00PM - 2:30PM

AIMMS (Paragon Decision Technology)
AIMMS for Advanced Optimization
M100A

American Optimal Decisions
Portfolio Safeguard
M100B

AnyLogic North America
Multi-Method Modeling in AnyLogic
M100C

Gurobi Optimization
Recent Improvements in Gurobi Solvers
M100D

JMP Software from SAS
JMP® Workshop: Interactive and Visual Data Analysis with JMP 11
M100E

MOSEK, ApS
MOSEK: A Software Package for Large-Scale Linear and Conic Optimization
M100G

Palisade Corporation
Risk & Decision Assessment Using @RISK
M100H

3:00PM - 5:30PM

FICO
Introducing Xpress-Nonlinear and Optimization on the FICO® Analytic Cloud
M100A

Frontline Systems, Inc.
Data Mining, Simulation and Optimization in Microsoft Excel and Office 365
M100C

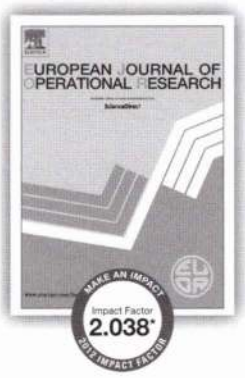
GAMS Development Corporation
Fundamentals and Recent Developments of the GAMS System
M100D

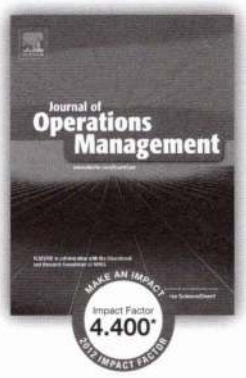
IBM
Building a Smarter Planet with Decision Optimization
M100E

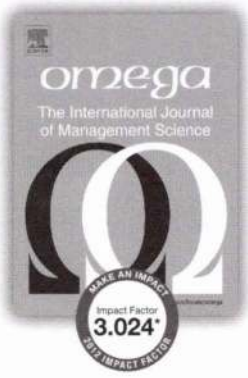
SAS
Solving Business Problems with SAS Analytics and OPTMODEL
M100G

ELSEVIER

NEWS FROM ELSEVIER JOURNALS

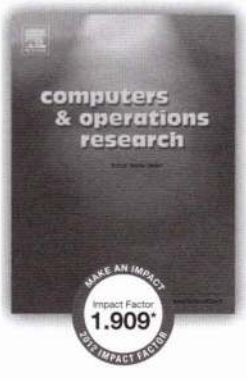




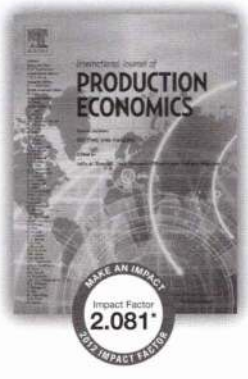


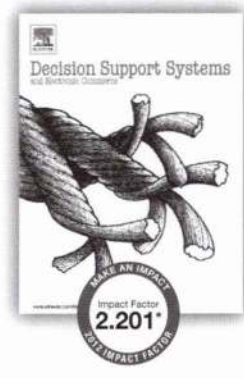












New Editor-in-Chief

Michael F. Gorman *(University of Dayton, USA)* became the new Editor-in-Chief of *Surveys in Operations Research and Management Science* in January, 2013.

Calls for Papers

Our subject page features a full list of active calls for papers, such as these from *Socio-Economic Planning Sciences:*

- Sustainable development issues in natural resource industries
- Data Envelopment Analysis in the Public Sector

Visit our subject page for the latest news, calls for papers and special issues from Elsevier journals

www.elsevier.com/decisionsciences

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Decision Sciences

Whether you work in industry, consulting or government – whether you are doing descriptive, predictive or prescriptive analytics/O.R. work – you'll find the best applications resources at the INFORMS Annual Meeting.

All sessions are in the Convention Center unless noted otherwise.

PLENARY AND KEYNOTE PRESENTATIONS

Advanced Analytics: Empowering Operations Research
Sunday, 3:10pm-4:00pm; Ballroom A, Level 1
Anne G. Robinson, Director, Supply Chain Strategy and Analytics, Verizon Wireless, and President of INFORMS

Reprise of the 2013 Edelman Award-Winning Presentation: Delta Programme - Economically Efficient Standards to Protect the Netherlands Against Flooding
Monday, 3:10pm-4:00pm; Auditorium 2, Level 1
Sponsored by CPMS, The Practice Section of INFORMS

The Physics of the Target Guest
Monday, 3:10pm-4:00pm; Auditorium 3, Level 1
Mark von Oven, Director of Merchandising Analytics, Reporting and R&D, Target Corporation

2013 INFORMS Prize Winner: Ford Motor Company – Ford Motor Company Transforms Its Business Using OR and Analytics
Sunday, 4:30pm-6:00pm; 200J, Level 2 (SD10)
Erica Klampfl, Technical Leader, Ford Motor Company

Innovative Applications in Analytics Award 2013 Winner Reprise - Machine Learning for Power Grid Reliability: Predicting Manhole Events in New York
Sunday, 4:30pm-6:00pm; 200I, Level 2 (SD09)
Cynthia Rudin, Assistant Professor, Massachusetts Institute of Technology
Sponsored by the Analytics Section of INFORMS

Innovative Applications in Analytics Award Competition
Monday, Track 9 (MA, MB, MC); 200I, Level 2
Competitors include FICO, Fiserv, US Air Force Academy, HP Global Analytics, University of Cologne, Ford Motor Company, IBM Research, MITRE Corporation, HP Platform Services.

2013 Daniel H. Wagner Prize Competition
The Daniel H. Wagner Prize is awarded for a paper and presentation that describe a real-world, successful application of operations research or advanced analytics. Competitors for the 2013 prize include HERA, University of Alabama, IBM Research, University of Goettingen and Technion-Israel Institute of Technology.

Competition
Monday, Track 39 (MA, MB, MC); Auditorium 3, Level 1

Award Presentation & Winner's Reprise
Tuesday Keynote, 3:10pm-4:00pm; Auditorium 2, Level 1
Sponsored by CPMS, The Practice Section of INFORMS

ANALYTICS & PRACTICE TRACKS

These tracks showcase O.R. and analytics in practice at a wide range of companies and organizations. The presentations span the entire length of the meeting and are scheduled for Track 9, 200I (Level 2) and Track 10, 200J (Level 2):

Workforce Analytics
Business Analytics in the Big Data Era
Big Data Analytics for Cyber Security
Challenges and Opportunities in Healthcare Analytics
Quantitative Methods in Analytics
Dynamic Pricing and Inventory Control
Risk-Averse Decision Models
Supply Chain Analytics
Marketing Analytics
Improving Security via Analytics
Certified Analytics Professional (CAP®) and Continuing Education
Outsourcing and/or Offshoring Analytics

MORE ANALYTICS & PRACTICE SESSIONS & EVENTS

Software Demonstrations
Sunday-Wednesday
See pages 33-36 for abstracts and room locations.
Featuring applications you can use at work or in research. Learn about new product releases, case studies and software presented by leading vendors and solution providers.

Tutorials
Sunday-Wednesday, Track 49, 205B, Level 2
Tuesday, TD18, 205B, Level 2
See pages 31-32 for abstracts.
These 90-minute sessions offer an in-depth look at current methodologies. Topics include modeling choice, risk-averse optimization, simulation optimization, organ transplant operations, portfolio optimization and more.

INFORMS Analytics Section Business Meeting & Reception
Monday, 6:15pm-7:15pm; 200I, Level 2
The Analytics Section invites all attendees to participate in this business meeting and reception. Enjoy light refreshments and help chart the course for the future of the section.

CPMS Isolated Practitioner Workshop & Reception
CPMS Isolated Practitioners Workshop
Monday, 6:15pm-7:15pm; 201A, Level 2
Geared to the interests of isolated practitioners, the "Lone Rangers" of OR/MS. All are welcome; wine and cheese will be served.

CPMS, The Practice Section of INFORMS
Tuesday, 7:00am-9:00am, Hilton, Marquette 5, Fl.2
All CPMS members are invited to attend! Enjoy a complimentary continental breakfast while learning more about the many practice activities that CPMS sponsors and administers.

Certified Analytics Professional (CAP®) Reception
Tuesday, 6:15pm-7:15pm; 200I, Level 2
Current CAPs, future CAPs and those interested in CAP certification are welcome. Members of INFORMS Analytics Certification Board will make a short presentation and answer questions.

2013 Combined Colloquia and Teaching Effectiveness Colloquium
Friday-Saturday
Hilton - schedule and room locations on page 7.
The Teaching Effectiveness (TEC), Future Academician (FAC) and Future Practitioner (FPC) Colloquia begin their activities with a Friday evening dinner meeting, and continue a full-day Saturday program. Participation in the colloquia is by nomination only.
Sponsored by Omega Rho.

Organization Science: Dissertation Proposal Competition
Saturday, 8:30am-5:00pm
Center - 101D, Level 1
This competition is one of the most prestigious available to doctoral students studying organizations. Finalists present their dissertation proposals and receive detailed feedback from a panel of respected organizational scholars who act as judges.

CIST 2013 – Conference on Information Systems and Technology
Saturday-Sunday
Center - Schedule & rooms, page 7-8
The goal of CIST is to engage academic and industry researchers in a dialogue that examines all aspects of theoretical and empirical research in information systems.
Sponsored by Carnegie Mellon University, H. John Heinz III College; Georgia Institute of Technology, Ernest Scheller Jr. College of Business; MIS Quarterly; Purdue University; Indian School of Business, SRITNE; University of California at San Diego, Rady School of Management; University of Calgary; University of Connecticut, Dept. of Operations & Information Management; University of Minnesota, Carlson School of Management; University of Minnesota, SOBACO; University of Texas at Dallas; and University of Washington, Michael G Foster School of Business.

In Honor of Saul Gass
Monday, 11:00am-2:30pm (MB11)
Center - 201A, Level 2
Monday, 4:30pm-6:30pm (MD34)
Center - 211D, Level 2
These special sessions honor the memory of Saul Gass, an exemplary member of the OR community and a great mentor to students. The presentations will touch on his many contributions to the profession.

INFORMS Fellows Luncheon
By Invitation Only
Monday, 12:45pm-2:30pm
Hilton - Grand C, Fl. 3
This luncheon honors INFORMS Fellows, examples of outstanding lifetime achievement in operations research and the management sciences. These individuals have demonstrated exceptional accomplishments and made significant contributions to the advancement of OR/MS over a period of time. Their service to the profession and to INFORMS has culminated in election to the INFORMS Fellow Award

Class of 2013 newly-elected INFORMS Fellows:
Daniel Bienstock
Michael W. Carter
Morris Cohen
Zvi Drezner
T.C. Hu
Sheldon H. Jacobson
Patrick Jaillet
Jon Lee
Anna Nagurney
Sheldon M. Ross
Martin Savelsbergh
David B. Shmoys

Minneapolis Area Workshop on O.R. for High School Math Teachers
Tuesday, October 8
University of Minnesota, STEM Education Center
8:00am-3:00pm
www.mindsetproject.org
This special workshop for high school mathematics teachers is offered by Wayne State University, Detroit, Michigan. The course builds on algebraic modeling concepts developed in Algebra II, and all of the material presented is developed around real-world contexts that answer the question "When will I ever use this?" The workshop is designed for a wide range of student mathematical abilities.
Sponsored by Wayne State University and INFORMS.

Researchers, practitioners and students share their O.R. and analytics projects in these special sessions presented as poster displays, laptop demonstrations and other creative formats. Presenters benefit from the interactive critique, suggestions and encouragement from colleagues working in similar areas. Attendees benefit by being exposed to a broad range of topics, application areas, problems, methodologies and solutions – all in a condensed format and space.

thank you

GUROBI OPTIMIZATION

Interactive Sessions

Monday, 12:30pm-2:30pm
Tuesday, 12:30pm-2:30pm
Convention Center – Exhibit Hall D
Interactive Session Chairs: Stephanie Snyder, USDA Forest Service, Jeff Linderoth, University of Wisconsin.

Abstracts and authors for posters are listed in the chronological program, under the day and time for each Interactive Session.

Monday Page 203-206
Tuesday Page 305-308

Interactive Competition

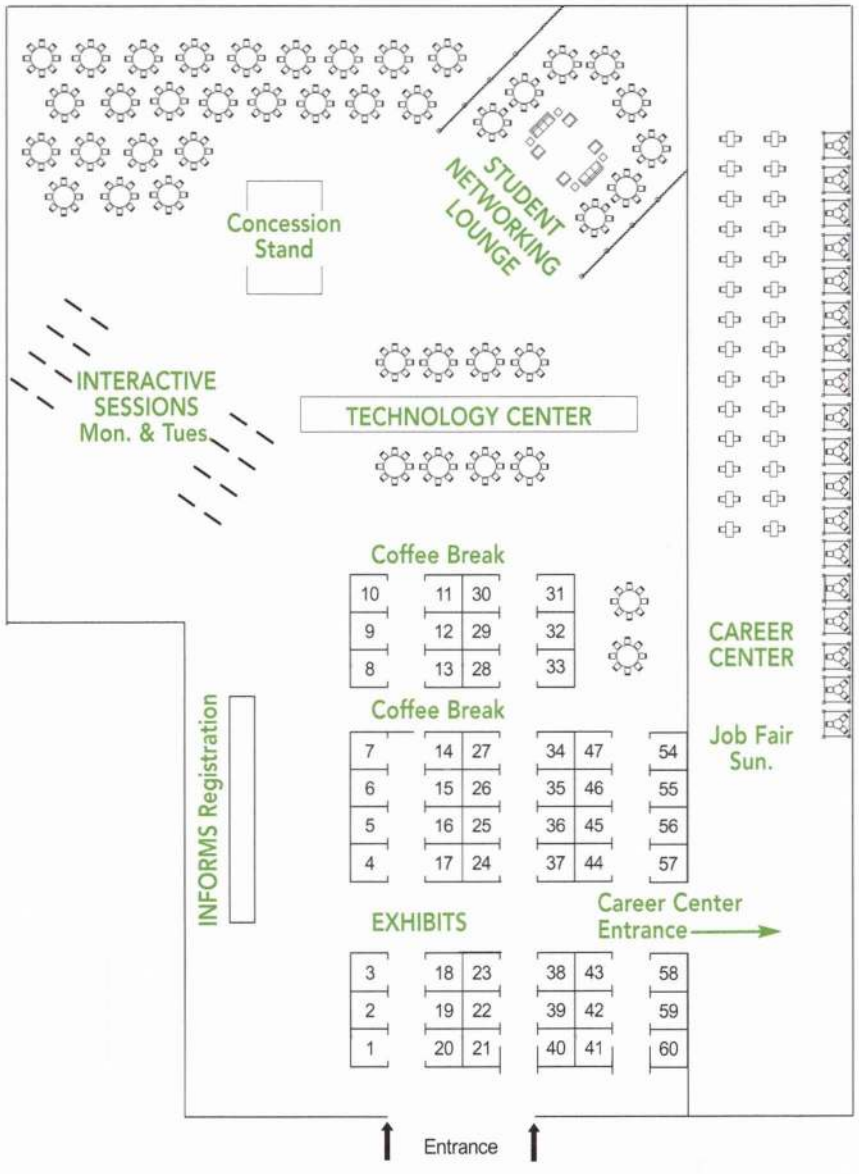
INFORMS places special emphasis on high-quality poster presentations. All interactive session presenters were invited to submit their posters to the competition. In Round 1 of the process, submitters sent a PDF of their finished poster to the judging panel for review. The judges have evaluated these submissions and selected a group of semifinalists. The judging panel is made up of distinguished ORMS professionals, both academics and practitioners, many of whom are INFORMS leaders.

In Round 2, the judging panel will review the semifinalist presentations during the Interactive Sessions in Minneapolis. In Round 3 – also held during the sessions in Minneapolis – the judges will name the 1st, 2nd and 3rd place winners. There will be three winners identified and awarded each day. Recognition includes a plaque, an award check, and announcements in INFORMS newsletters and web site.

Competition Judges

Oguz Alagoz, University of Wisconsin
Gad Allon, Northwestern University
Turgay Ayer, Georgia Tech
Nathan Brixius, Nielsen
Jeff Camm, University of Cincinnati
Myun-Seok Cheon, ExxonMobil
John Chinneck, Carleton University
Richard Church, Univ. of California, Santa Barbara
Jeffrey Herrmann, University of Maryland
Mike Hewitt, Rochester Institute of Technology
Michael Katehakis, Rutgers University
Roy Kwon, University of Toronto
Leo Lopes, SAS
Cameron MacKenzie, Naval Postgraduate Sch.
David Martell, University of Toronto
David Novak, University of Vermont
Larry Snyder, Lehigh University
Bharatendu Srivastava, Marquette University
Michael Trick, Carnegie Mellon University
Anita Tucker, Harvard Business School
Jean-Paul Watson, Sandia National Laboratories

convention center exhibit hall





SAN FRANCISCO 2014

INFORMS ANNUAL MEETING

BRIDGING DATA AND DECISIONS

November 9-12, 2014

Hilton San Francisco & Parc 55 Wyndham

San Francisco, California

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http://meetings2.informs.org/sanfrancisco2014

SUNDAY

Welcome & Plenary

10:00am-10:50am
Ballroom A, Level 1

Welcome

Anne G. Robinson, President, INFORMS
Director, Supply Chain Strategy and Analytics, Verizon Wireless

Plenary

Benefits of Systems Science for Policy Support
Pavel Kabát
Director/CEO, International Institute for Applied Systems Analysis (IIASA)

Narrowly focused, single-disciplinary science alone cannot adequately underpin policies and solutions to resolve major sustainability challenges. We must rapidly refocus intellectual and economic investments toward multi-scale, integrated, interdisciplinary approaches that consider social, economic and environmental aspects, that look across and between borders and sectors, and that identify feedbacks or the co-benefits of a policy or management decision, before it is made. One example of this "systems" approach is the Global Energy Assessment (GEA), a multiyear, multidisciplinary study (coordinated by IIASA). The GEA links energy to climate, air quality, human health and mortality, economic growth, urbanization, water, land use and other factors. The GEA scenarios find that energy access for all (by 2050) is possible with co-benefits of limiting warming to 2°C, improving air quality and human health, and stimulating economic growth within a green economy framework.

Realizing the sustainability goals will require investment in integrated analyses to fully understand the Earth system (human and natural). This must be enabled by substantial growth in public-private partnerships that stimulate and fund collaboration between social and natural scientists and that engage key stakeholders and the user community at all stages of the research cycle–from inception to implementation.



Pavel Kabát is Director and Chief Executive Officer of the International Institute for Applied Systems Analysis (IIASA). He is also Professor of Earth System Science at Wageningen University in the Netherlands. He has over 25 years' experience leading interdisciplinary and international research teams investigating global environmental change, with focus on climate hydrology and water cycles. He is author and co-author of over 200 refereed publications, including nine books, and co-editor of six special issues of peer reviewed international journals. Between 1994 and 2010, Dr. Kabát chaired several Scientific Steering Committees of the major global environmental change programs, dealing with both the physical and the biogeochemical aspects of the earth system. He is a co-recipient of the 2007 Nobel Peace Prize as one of the Lead Authors of the IPCC, co-recipient of The Zayed International Prize for the Environment (2006) as one of the authors of the Millennium Ecosystem Assessment, and a recipient of the Dahlem Foundation International Prize (Berlin, 1998) and NASA Goddard Space Flight Centre Prize (Maryland, USA 1997).

Plenary

3:10pm-4:00pm
Ballroom A, Level 1

Introduction

Robert G. Haight, General Chair, INFORMS Annual Meeting
Research Forester, Northern Research Station, USDA Forest Service

Plenary

Advanced Analytics: Empowering Operations Research
Anne G. Robinson
Director, Supply Chain Strategy and Analytics, Verizon Wireless

Analytics, especially data analytics, has been the focal point of discussions in board rooms and at C-level meetings for the last few years. From a multinational consumer electronics corporation Best Buy to a retail chain Target, from a telecommunications service company Verizon to networking giant Cisco, almost every leading global brand has the desire to crunch data into knowledge, and ultimately into profits and improved customer service by advanced analytics. The successes of companies like Google and Amazon, which have achieved turning data into gold, are not only shaping our daily lives, but also disrupting dominant business models in every industry.

Recent advances in information system capabilities, like abundance and inexpensive data storage, cloud based solutions and distributed computing paradigms have opened new possibilities for collecting and processing data at an unprecedented volume and speed. This data tsunami, along with advanced computing and analysis capabilities, provide Operations Research professionals with innovative ways to build and validate their models, and to communicate results and insights to upper management. The abundance of data and the increased confidence in analytics enable researchers to explore unchartered territories and to develop and test exciting new models and theories. As the INFORMS community, we have the right people both in academia and in practice, the assets and the reputation (i) to champion and flourish the analytics movement, (ii) to promote and standardize analytics education, and (iii) to pioneer certification in analytics. During these electrifying times, we should enjoy the attention of top executives and embrace analytics to grow our community. Analytics is not diluting our field, but rather empowering operations research.



Anne G. Robinson is the Director of Supply Chain Strategy and Analytics for Verizon Wireless. Her team is responsible for leading strategic efforts across the Supply Chain organization, leveraging advanced analytics to implement processes and procedures that lead to improved product life cycle management, more efficient network equipment utilization, working capital optimization, and cost reduction. Prior to joining Verizon Wireless, Robinson spent several years with Cisco Systems where her responsibilities included managing advanced analytics, business intelligence, and performance management teams across the supply chain. She and her team were also responsible for evaluating and improving the distribution inventory network as well as establishing a statistical forecasting capability for predicting demand. As the driving force for many foundational and cross-functional process innovations, she helped establish Cisco's presence and recognition as a leader in business intelligence and analytics, including being inducted into the balanced scorecard hall of fame. A PhD in Industrial Engineering from Stanford University, Anne is the President of INFORMS. She is a popular industry speaker, has served on several advisory boards including the SAS Analytical Customer Advisory Board and was a topical editor for the *Encyclopedia of Operations Research and Management Science*. A frequent tweeter, you can follow Dr. Robinson @agrobins.

MONDAY

plenary

Omega Rho Distinguished Lecture
10:00am-10:50am
Ballroom A, Level 1

Data-Driven Operations Research Analyses in the Public Sector

Lawrence M. Wein, Professor, Graduate School of Business, Stanford University

Lawrence M. Wein will describe several recent projects in the public sector, including screening and treatment for childhood obesity, allocating blood for transfusions, optimizing ballistic imaging performance using spatiotemporal crime data, allocating ready-to-use food to children in developing countries, and optimizing the biometric aspects of India's universal identification (UIDAI) program. Each project started with a large longitudinal data set that guided the mathematical modeling, and resulted in a recommended policy that outperforms the current policy. For each project, he will briefly describe the problem motivation, the data set, the mathematical model (which was embedded into an optimization problem), the statistical analysis required to calibrate the model, the numerical results from solving the optimization problem, and the policy implications.

omega rho

OMEGA RHO, the official Honor Society of INFORMS, was founded in 1976 to recognize superior scholarship and encourage leadership in operations research, management science, and related disciplines. The society has 40 active collegiate chapters, more than 5,000 student and faculty members and is a member of the Association of College Honor Societies. In addition to sponsoring OMEGA RHO Distinguished Lectures at INFORMS Annual and International meetings, OMEGA RHO provides financial support to the annual INFORMS Colloquium. Honorary Membership in OMEGA RHO is bestowed upon individuals who provide leadership and extraordinary support for the encouragement of operations research and management science through their professional activities. Prior to delivering the OMEGA RHO Distinguished Lecture, Lawrence M. Wein will be inducted as an Honorary Member of OMEGA RHO.



Lawrence M. Wein is the Jeffrey S. Skoll Professor of Management Science at the Graduate School of Business, Stanford University. He received a BS in Operations Research and Industrial Engineering from Cornell University in 1979 and a PhD in Operations Research at Stanford University in 1988. He was a professor at MIT's Sloan School of Management from 1988 to 2002. His research interests are in manufacturing and public health. Early in his career, he worked on heavy traffic analysis of queueing models for manufacturing systems, and his research on workload regulating release was implemented widely in the semiconductor industry. Later he worked on a variety of health problems related to kidney transplants, and treatments for HIV (which led to a successful multi-center clinical trial on drug-switching protocols), cancer, Alzheimer's disease and influenza. After the September 11, 2001 attacks, much of his research focused on homeland security, including bioterror attacks involving smallpox, anthrax and botulinum toxin, preventing nuclear weapons from entering ports and cities, preventing terrorists from entering at ports of entry and between ports of entry, and the shelter vs. evacuation decision after a nuclear blast. His more recent work addresses pandemic influenza, post-traumatic stress disorder in Operation Iraqi Freedom soldiers, and space debris. He was Editor-in-Chief of *Operations Research* from 2000 to 2005. He has been awarded a Presidential Young Investigator Award, the Erlang Prize, the Koopman Prize, the INFORMS Expository Writing Award, the Philip McCord Morse Lectureship, the INFORMS President's Award, the Frederick W. Lanchester Prize, the George E. Kimball Medal, and a best paper award from *Risk Analysis*. He is an INFORMS Fellow, a M&SOM Fellow and a member of the National Academy of Engineering.

keynote

Reprise of 2013 Edelman Award-Winning Presentation
3:10pm-4:00pm
Auditorium 2, Level 1

Delta Programme - Economically Efficient Standards to Protect the Netherlands Against Flooding
CPB Netherlands Bureau for Economic Policy Analysis: Carel Eijgenraam
Deltares: Jarl Kind, Carlijn Bak, Jaap Kwadijk
Tilburg University: Ruud Brekelmans, Dick den Hertog
Delft University of Technology: Kees Roos
HKV Consultants: Matthijs Duits
Ministry of Infrastructure and the Environment: Pieter Vermeer
Delta Programme: Wim Kuijken

In the Netherlands, flood protection is a matter of national survival. In 2008, the Second Delta Committee recommended that legal flood protection standards be increased at least tenfold to compensate for population and economic growth since 1953, which would have involved dike improvement investments estimated at 11.5 billion Euros. A research group was charged with developing efficient flood protection standards in a more objective way. Mixed integer nonlinear programming was used to demonstrate the efficiency of increasing the legal standards only in three critical regions. Monte Carlo analysis confirmed the robustness of this outcome. These results were accepted by the State Secretary in 2012 as basis for legislation. This successful application of O.R. yields not only a highly significant increase in protection for these regions, but also some 7.8 billion Euros in cost savings. The methods could be used in decision-making for other flood-prone areas worldwide.

keynote

3:10pm-4:00pm
Auditorium 3, Level 1

The Physics of the Target Guest
Mark von Oven
Director of Merchandising Analytics, Reporting and R&D, Target Corporation

Over the course of the last few centuries, humanity has made astounding progress in the field of physics. The concept of "atom" was introduced to us by Democritus, while Newton introduced us to gravity. Maxwell created his famous equations which unified electricity with magnetism and of course, who could forget Einstein and his creation of his theory of special relativity. Each of these scientific feats are absolutely amazing in their own right and yet still today, theoretical physicists continue to push the boundaries of science with new discoveries and continued attempts at a Theory of Everything... a theory that fully explains and links together all known physical phenomena to predict an outcome. Stephen Hawking once said that such a theory would give us the ability to "read the mind of God." Fortunately for us, all we're trying to do is figure out how to best serve the Target Guest.

In the retail landscape we've made significant progress over the past few decades in the world of Business Intelligence & Analytics (BI&A) at Target. Can our extensive work in pricing, promotion, product and placement be used as input to a Unified Theory of Loyalty that explains why she buys what she buys and where she chooses to buy it from? Does such a thing even exist? With new capabilities like Big Data and increasingly growing venues like Social & Mobile to capture new guest data, will we finally have comprehensive inputs to such an equation? Target continues its analytical journey and this presentation will explain how BI&A plays a key role in that evolution, what seems to be working well and how all of this just might fit into the concept of a Grand Unified Theory.



Mark von Oven is Director of Merchandising Analytics, Reporting and R&D at Target Corporation in Minneapolis, MN. Prior to joining Target he spent 14 years at Procter & Gamble, most recently as a leader in North America Business Intelligence Customer Analytics. Mark obtained his bachelor's degree in Computer Engineering at the University of Florida and an MBA from Xavier University.

the franz edelman award

The Franz Edelman Award for Achievement in Operations Research and the Management Sciences calls out, recognizes and rewards outstanding, high-impact applications of OR/MS. Each year, six to seven finalists compete in the "Super Bowl" of O.R. in practice. The 2013 finalists include The Kroger Company, Baosteel, Chevron Corporation, Dell, Inc. and McKesson Corp. In this keynote, the first-place Delta Programme team will reprise their winning presentation.

TUESDAY, OCTOBER 8

plenary

10:00am-10:50am
Ballroom A, Level 1

Health Care Analytics
Dimitris Bertsimas, Boeing Professor of Operations Research, Co-Director of the Operations Research Center, Massachusetts Institute of Technology

We present an analytics approach to personalized diabetes management and the design of clinical trials for cancer. First, we present a system to make personalized lifestyle and health decisions for diabetes management, as well as for general health and diet management. In particular, we address the following components: (a) efficiently learning preferences through a dynamic questionnaire that accounts for human behavior; (b) modeling blood glucose behavior and updating these models to match individual measurements; and (c) using the learned preferences and blood glucose models to generate an overall diet and exercise plan using mixed-integer robust optimization. We have implemented our system as an online application, which we demonstrate. (Joint work with Allison O' Hair.)

Next, we propose an analytics approach for the analysis and design of clinical trials that provides insights into what is the best currently available drug combination to treat a particular form of cancer and how to design new clinical trials that can discover improved drug combinations. We develop semi-automated extraction techniques to build a comprehensive database of data from clinical trials. We use this database to develop statistical models from earlier trials that are capable of predicting the survival and toxicity of the combination of the drugs used, when the drugs used have been seen in earlier trials, but in different combinations. Then, using these statistical models, we develop optimization models that select novel treatment regimens that could be tested in clinical trials, based on the totality of data available on existing combinations. We also present concrete models for gastric cancer, one of the leading causes of cancer death worldwide. Ultimately, our approach offers promise for improving life expectancy and quality of life for cancer patients at low cost. (Joint work with Allison O' Hair, Stephen Relyea and John Silberholz).



Dimitris Bertsimas is currently the Boeing Professor of Operations Research and the co-director of the Operations Research Center at the Massachusetts Institute of Technology. He received a BS in Electrical Engineering and Computer Science at the National Technical University of Athens, Greece in 1985, an MS in Operations Research at MIT in 1987, and a PhD in Applied Mathematics and Operations Research at MIT in 1988. His research interests include analytics and their applications, especially in a variety of industries with particular emphasis in healthcare. He has co-authored more than 150 scientific papers and has co-authored three graduate level textbooks. He is currently Department Editor in Optimization for *Management Science* and former Area Editor in Operations Research in *Financial Engineering*. He is a member of the National Academy of Engineering, has received several research awards including the Farkas prize (2008), the Erlang prize (1996), the SIAM prize in optimization (1996), the Bodossaki prize (1998) and the Presidential Young Investigator award (1991-1996).

keynote

2013 Daniel H. Wagner Prize Winner Announcement and Reprise
3:10pm-4:00pm
Auditorium 2, Level 1

The Daniel H. Wagner Prize is awarded for a paper and presentation that describe a real-world, successful application of operations research or advanced analytics. The prize criteria emphasize innovative, elegant mathematical modeling and clear exposition.

Daniel H. Wagner earned his PhD in mathematics from Brown University in 1951. He began his career in the US Navy's Operations Evaluation Group (OEG) at the Pentagon, where he worked on operations research for naval warfare. His first entrepreneurial adventure was forming a partnership with his friend and colleague, John D. Kettelle. The firm of Kettelle and Wagner operated from 1958 to 1963. In 1963, he created the firm of Daniel H. Wagner Associates, Inc., which is still in existence today.

During his years as president and principal owner of Wagner Associates, Dan brought many high-quality mathematicians into the operations research community. This led to significant advances in the firm's fields of endeavor and delivery of significant applications to the Navy, Coast Guard, and other clients; many of these applications are still in service today. After retirement from his eponymous company, Dan Wagner continued his commitment to the field of operations research, serving in various teaching and research positions with the US Naval Postgraduate School and the US Naval Academy. He was an active member of ORSA, and then INFORMS, for more than 40 years.

keynote

IFORS Distinguished Lecture
3:10pm-4:00pm
Auditorium 3, Level 1

Computational Disaster Management: The Role of OR/MS
Pascal Van Hentenryck, Optimization Research Group Leader, National ICT Australia; Professor, University of Melbourne

The frequency and intensity of natural disasters has significantly increased over the past decades, and this trend is predicted to continue. Natural disasters have dramatic impacts on human lives and on the socio-economic welfare of entire regions. They are identified as one of the major risks of the East Asia and Pacific regions. Dramatic events such as Hurricane Katrina and the Tohoku tsunami have also highlighted the need for OR/MS tools in preparing, mitigating, responding and recovering from disasters. I will present an overview of some recent progress in using OR/MS for disaster management and, in particular, in relief distribution, power system restoration, and evacuation planning and scheduling. I will argue that OR/MS has a significant role to play in all aspects of disaster management, from policy formulation to mitigation, operational response and recovery, using examples of systems deployed during hurricanes Irene and Sandy. Moreover, I will indicate that disaster management raises significant computational challenges for OR/MS technologies which must optimize over complex infrastructures in uncertain environments. Finally, I will conclude by identifying a number of fundamental research issues for OR/MS in this space.



Pascal Van Hentenryck leads the Optimization Research Group at National ICT Australia (NICTA), the center of excellence for ICT research in Australia. The optimization research group at NICTA pursues fundamental research in optimization, simulation and algorithmic decision theory, as well as applied research focused on logistics and supply chains, energy systems and disaster management. He is also a professor at the University of Melbourne, where he teaches a massively online course on discrete optimization. Van Hentenryck is the recipient of two honorary degrees and is a fellow of the Association for the Advancement of Artifical Intelligence. He was awarded the 2002 INFORMS ICS Award for research excellence at the intersection of operations research and computer science, the 2006 ACP Award for research excellence in constraint programming, and the 2010-2011 Philip J. Bray Award for Excellence in Undergraduate Teaching at Brown University. Van Hentenryck is the author of five MIT Press books and has developed a number of innovative optimization systems that are widely used in academia and industry. His research on disaster management has been deployed to help federal agencies in the United States mitigate the effects of hurricanes on coastal areas.

WEDNESDAY, OCTOBER 9

keynote

Reprise of 2013 UPS George D. Smith Prize Award-Winning Presentation
10:00am-10:50am
Auditorium 2, Level 1

Naval Postgraduate School: Robert Dell, Walter DeGrange, Ronald Fricker

The Naval Postgraduate School's (NPS) Operations Research (OR) department was awarded the 2013 UPS George D. Smith Prize for effective and innovative preparation of students to be good practitioners of operations research, management science or analytics. NPS began offering its degree program in OR in 1951, making it the first OR degree program in the United States. The program is inextricably linked to its sponsor, the U.S. Department of Defense, in a unique relationship that ensures NPS students and faculty are focused on critical and important problems facing the military. Our students bring first-hand knowledge of the challenges our organization faces and leave as OR practitioners to immediately meet these challenges. In this presentation, we demonstrate our:

- strong ties to our "industry," the Department of Defense (DoD);
- commitment to effective and innovative preparation of our students to be good practitioners of OR;
- focus on teaching, demonstrating, and expanding competence in OR practice, by our students, our alumni, and our faculty; and,
- impact on the practice of OR in the DoD, particularly how those impacts have and continue to improve DoD operational efficiency and effectiveness.

ups george d. smith prize

The UPS George D. Smith Prize recognizes an academic department or program for effective and innovative preparation of students to be good practitioners of O.R., management science or analytics. The UPS George D. Smith Prize is created in the spirit of strengthening ties between industry and the schools of higher education that graduate young practitioners of operations research. INFORMS, with the help of CPMS, awards the prize annually to an academic department or program for effective and innovative preparation of students to be good practitioners of operations research, management science, or analytics. The UPS George D. Smith Prize is named in honor of the late UPS Chief Executive Officer who was a champion of operations researchers at a leading Fortune 500 corporation. UPS has generously underwritten the award in his memory.



Robert F. Dell is Professor and Chair of Operations Research at the Naval Postgraduate School where he has been an active contributor to the OR Department's accomplishments since joining the faculty as an Assistant Professor in 1990. He has received research support from every uniformed service for topics ranging from naval capital planning to army base realignment and closure. He has also applied optimization in the private sector in areas ranging from production scheduling to supply chain design. His recent awards include a 2011 Department of the Army Dr. Wilbur B. Payne Award for Excellence in Analysis, a 2011 Department of the Navy Superior Civilian Service Award, the 2008 Military Operations Research Society David Rist Prize, and the 2007 Military Operations Research Society Richard H. Barchi Prize.

keynote

10:00am-10:50am
Auditorium 3, Level 1

Pricing and Product Design in a Data-Driven Economy

Guillermo Gallego
Liu Family Professor, Department of Industrial Engineering and Operations Research, Columbia University

We live in an increasingly data-intensive economy in which understanding customers, designing products and pricing them correctly are crucial capabilities for survival and profitability. So-called "Big Data" in the form of massive data bases specifying which customers have bought what products at what prices in the past is enabling deeper, data-driven understanding of customer behavior that was previously available. In this talk we discuss efforts by companies like Hewlett Packard to use big data to understand customer's buying and product substitution patterns under competition. We also report efforts to design and price bundles as branded products by companies like Air Canada, and efforts to offer consumption and fulfillment options by companies such as United Airlines and Hilton Hotels and Resorts.

Management science, operations research and data analytics are playing increasingly important roles in the fundamental business decisions of designing and pricing products to meet customer needs. We will discuss how companies can mine sales, prices and product attributes to develop product similarity metrics to identify products whose prices are out of range, products that are candidate for discontinuance, and opportunities for the introduction of new products. We will further describe advances in assortment and price optimization that rely on discrete choice models. We will also discuss how these can be combined to enable companies to better design and price bundles, warranties, and ancillary services. Finally, we will discuss how these capabilities can be used to inform novel approaches to product and service design that rely on real options that allow sellers to hedge against demand uncertainty while providing tangible benefits to buyers.



Guillermo Gallego joined Columbia University's IEOR Department in 1988, where he has been conducting research in the areas of inventory theory, supply chain management, revenue management, and dynamic pricing. He was inducted as an INFORMS Fellow in 2012 and as an MSOM Fellow in 2013. He has received many awards including the INFORMS Revenue Management Section Prize (2005), the Revenue Management Historical Prize (2011) and the Revenue Management Practice Prize (2012). He has published influential papers in the leading journals in management science and operations research and has served in a variety of editorial positions for many of the same journals. His work has been supported by numerous industrial and government grants.

Gallego has consulted for Hewlett Packard, IBM, Lucent, Nomis Solutions, and Sabre Airline Solutions. He has also worked with government agencies such as the National Research Council, the National Science Foundation and the Ireland Development Agency. He spent his 1996–97 sabbatical at Stanford University and was a visiting scientist at the IBM Watson Research Center from 1999 to 2003. He was the chairman of the IEOR Department at Columbia University from July 2002 to June 2008. He received his MS and PhD in Operations Research from Cornell and a BA in Mathematics from the University of California at San Diego.

All tutorials are located in the Convention Center.

SUNDAY

■ SA49 - Room 101I
8:00am-9:30pm
Correlation Decay Method for Decision, Optimization and Inference in Large-Scale Networks
David Gamarnik, Massachusetts Institute of Technology

Many decision problems on networks involve solving hard algorithmic problems. In light of the size of many real life networks, one often has to resort to faster local algorithms which can provide the required computation effort scales. The correlation decay property is a method which provides a rigorous justification for the validity of such local algorithms. In this tutorial we illustrate the applications of the correlation decay method for several applications.

■ SB49 - Room 101I
11:00am-12:30pm
Sparse Solutions to Complex Models
Xin Chen, University of Illinois at Urbana-Champaign
Chung Piaw Teo, National University of Singapore

Recent years witnessed the proliferation of the notion of sparsity and its applications in operations research models. To bring to the attention and raise the interest of the operations research community on this topic, we present in this tutorial a wide range of complex models which admit sparse yet effective solutions. Our examples range from compressed sensing, optimization problems, game theory models, and two-stage stochastic programs with a few applications.

■ SC49 - Room 101I
1:30pm-3:00pm
Data-Driven Decision-Making in Non-Stationary Environments
Omar Besbes, Columbia University

A fundamental task that many dynamic decision-support systems face is to track underlying changes in the environment for better decisions. This tutorial will review classical work and recent approaches to decision-making in non-stationary and uncertain environments. We will present results on generic fundamental sequential decision problems but also review the specific challenges one faces in particular applications (e.g., dynamic pricing and inventory management).

■ SD49 - Room 101I
4:30pm-6:00pm
Modeling Choice
Vivek Farias, Massachusetts Institute of Technology

Choice modeling has become germane to the practice of Revenue Management in multiple industries. The next frontier of challenges appears to be in making the practice of choice modeling more "data driven" than it currently is. This tutorial will survey the modeling landscape and discuss estimation methodologies and their limitations. Connections with a host of applications, both traditional and modern will be stressed.

MONDAY

■ MA49 - Room 101I
8:00am-9:30am
Advances in Risk-Averse Optimization
Andrzej Ruszczynski, Rutgers University

We discuss main ideas of formalizing risk-averse preferences and using them in optimization problems: utility theories, risk measures, and stochastic order constraints. We also present methods for solving risk-averse optimization problems. Multistage risk-averse models will be discussed as well, in particular, time-consistency and decomposition.

■ MB49 - Room 101I
11:00am-12:30pm
Mixed-Integer Second-Order Cone Programming: A Survey
Hande Benson and Umit Saglam, Drexel University

In this tutorial, we present a survey of the literature on applications of and algorithms for mixed-integer second-order cone programming problems (MISOCPs). Applications include options pricing, portfolio optimization, network design and operations, and statistics, with some examples arising from the use of MISOCPs as relaxations or reformulations of MINLPs. The solution algorithms combine existing solution methods for SOCPs with extensions of MILP or MINLP methods.

■ MC49 - Room 101I
1:30pm-3:00pm
Optimal Placement in a Limit Order Book
Xin Guo, University of California-Berkeley

Algorithmic trading refers to the automatic and rapid trading of large quantities with orders specified and implemented by an algorithm. It essentially involves two steps by which the traders slice and place orders. The first step is known as the optimal execution problem and the second step is the much less-studied optimal placement problem. This tutorial reviews several simple models and approaches for the optimal placement problem, together with some relevant statistical issues.

■ MD49 - Room 101I
4:30pm-6:00pm
Network Search from a Game Theoretic Viewpoint
Steve Alpern, Warwick Business School

A Searcher wishes to find an unknown point H (hidden by the Hider) on a given network Q. He starts from a known point O and moves at unit speed until the first time T (the Payoff) that he reaches H. The "classical theory" begins in 1979 with the work of S. Gal for trees Q, and culminates with Gal's extension to weakly Eulerian networks in 2000. In between many other researchers contributed to the theory. We review the classical theory and present extensions in various directions.

TUESDAY

■ TA49 - Room 101I
8:00am-9:30am
Performance Variability in Mixed-integer Programming
Andrea Lodi, University of Bologna
Andrea Tramontani, IBM Italy

The performance of MIP solvers is subject to unexpected variability that appears, e.g., when changing from one computing platform to another, when permuting rows and/or columns of a model, etc. This phenomenon, observed for decades, has only recently started to be methodologically analyzed. We discuss the roots of performance variability, we provide tips to recognize it, and we point out some severe benchmarking misinterpretations. Finally, we report on recent attempts to gain from variability.

■ TB49 - Room 101I
11:00am-12:30pm
High-Frequency Trading and Modern Market Microstructure
Ciamac Moallemi, Columbia University

Driven by technological advances, modern financial markets have become an electronic world dominated by automated agents that interact algorithmically. Markets are now characterized by decision-making that evolves on a microsecond timescale, with activity fragmented across many exchanges and alternative market structures. This has led to challenging new decision problems for market participants. This tutorial explores some of the basic questions and resulting models.

■ TC49 - Room 101I
1:30pm-3:00pm
Simulation Optimization: A Concise Overview and Implementation Guide
Raghu Pasupathy, Virginia Tech
Soumyadip Ghosh, IBM TJ Watson Research

Simulation optimization (SO) is the problem of optimization in the presence of objective and constraint functions that can only be observed via a simulation. This tutorial is a concise guide to a few key SO flavors. Our intended audience is a sophisticated practitioner looking for algorithmic implementations, or a researcher looking to be gently initiated into the vast SO literature. Accordingly, our discussion will be kept at a very accessible level, without omitting key details.

■ TD49 - Room 101I
4:30pm-6:00pm
Stochastic Variational Inequality Problems: Applications, Analysis and Algorithms
Uday Shanbhag,Pennsylvania State University

We consider the stochastic variational inequality problem, where the components of the associated map may contain expectations. The focus of the tutorial is two-fold: (i) analysis - integration–free sufficiency conditions for existence are provided by combining Lebesgue convergence theorems with standard variational analysis; and (ii) computation - a range of stochastic approximation schemes are described for computing the associated solutions.

■ TD18 - Room 205B
4:30pm-6:00pm
Solid Organ Transplant Operations
Diwakar Gupta, University of Minnesota

The extreme shortage of organs makes it necessary to prioritize allocation of diseased-donor organs. The difficult task of setting such priorities rests with the Organ Procurement and Transplantation Network. This talk will describe efforts to improve Simulated Allocation Models, which are tools used by the Scientific Registry of Transplant Recipients to evaluate the impact of proposed allocation policies on the distribution of organs, waitlist statistics, and post-transplant outcomes.

Wednesday

■ WA49 - Room 101I
8:00am-9:03pm
Efficiency Concepts in MCDM, DEA and Finance
Pekka Korhonen, Aalto University School of Business

Efficient points, sets, and surfaces play important roles in Data Envelopment Analysis (DEA), multiple criteria decision making (MCDM), and portfolio selection in finance. The tutorial stresses the differences and similarities by which efficiency concepts manifest themselves in each of the three areas.

■ WB49 - Room 101I
11:00am-12:30pm
Superquantiles and their Applications to Risk, Random Variables and Regression
R. Tyrrell Rockafellar, University of Washington
Johannes O. Røyset, Naval Postgraduate School

Superquantiles are useful tools in risk modeling and optimization, with expanding roles beyond these areas. This tutorial provides a broad overview of superquantiles and their versatile applications. We see that superquantiles are as fundamental to the description of a random variable as the cumulative distribution function (cdf), they can recover the corresponding quantile function through differentiation, they are dual in some sense to superexpectations, which are convex functions uniquely defining the cdf, and they also characterize convergence in distribution. A superdistribution function defined by superquantiles leads to higher-order superquantiles as well as new measures of risk and error, with important applications in risk modeling and generalized regression.

■ WC49 - Room 101I
1:30pm-3:00pm
Portfolio Optimization: Models and Solution Approaches
John Beasley, Brunel University

We review financial portfolio optimization. Markowitz mean-variance portfolio optimization is relatively well known, but has been extended in recent years to encompass cardinality constraints. Less considered in the scientific literature are portfolio optimization problems such as: index tracking; enhanced indexation; absolute return; market neutral. We outline the mathematical optimization models that can be adopted for portfolio problems such as these and solution approaches that can be used.

All attendees receive free access to the **INFORMS 2013 *TutORials in Operations Research*** online book concurrently with the meeting. 2013 INFORMS Annual Meeting attendees will have access to 2013 *TutORials* ONLINE on October 1, 2013 (Members on January 1, 2014). Check back on the Annual Meeting website for information on how to access. You will need a username and password which is printed on your conference registration receipt; you can also request that information when you go to the online tutorials site. You can order the 2013 book or previous volumes (CDs 2005-2012) through the *TutORials* website https://www.informs.org/Pubs/Tutorials-in-OR. For more information, visit the INFORMS booths #55-57 in the exhibit hall.

Continuing Education

COURSES FOR ANALYTICS PROFESSIONALS

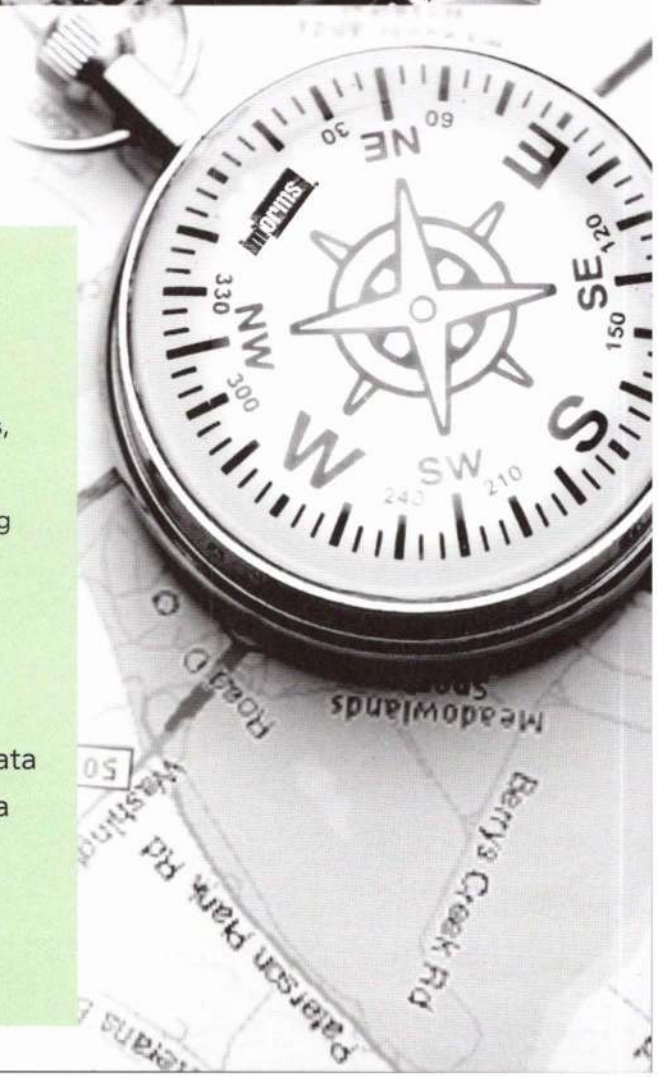
ESSENTIAL SKILLS FOR ANALYTICS PROFESSIONALS

Taught by Patrick Noonan, Professor, Practice of Decision & Information Analysis at Emory University, who has multiple teaching awards and broad business consulting experience. Some of the topic areas to be covered in this course include:

- » Problem Framing
- » Developing the Work Plan
- » Modeling
- » Testing
- » Presenting Results
- » Impact Assessment

This course will be held
Nov. 7-8, 2013 in Washington, D.C.





INFORMS Continuing Education program will offer its first two courses this fall. These intensive, two-day, in-person courses will provide analytical professionals with key skills, tools and methods that can be implemented immediately in a work environment.

Learn more about these courses including course outlines, instructor biographies, program objectives, pricing, and how to register at:
informs.org/continuinged
or contact Thedra White,
thedra.white@informs.org.

DATA EXPLORATION & VISUALIZATION

Taught by Galit Shmueli, SRITNE Chaired Professor of Data Analytics, Indian School of Business, and David Hardoon, Associate Director of Business Analytics, Ernst & Young Singapore. This course will address topics such as:

- » Accessing Data
- » Understanding Raw Data
- » Cleaning & Transforming Data
- » Exploring & Visualizing Data
- » Dimension Reduction

This course will be held
Oct. 3-4, 2013 in Minneapolis, MN

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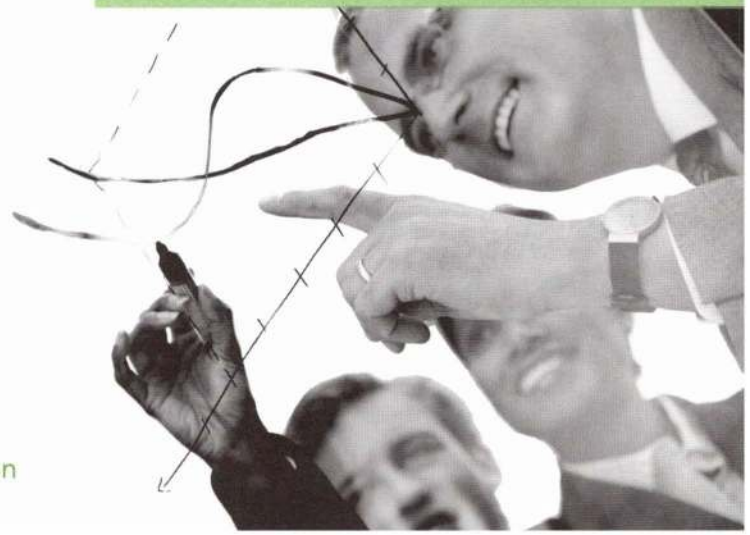
OCTOBER 5, 2013 - MINNEAPOLIS
Precedes INFORMS Annual Meeting
Minneapolis, MN
October 6-9, 2013

NOVEMBER 6, 2013 - SAN FRANSCISCO
Precedes IBM Data Mining Workshop
IBM Tech Center
San Francisco, CA

NOVEMBER 12, 2013 - NEW YORK CITY
Precedes SAS Data Mining Workshop
SAS Training Center
New York, NY

DECEMBER 12, 2013 -TORONTO
Queens School of Business
Lecture Theater
Toronto, Ontario, Canada

JANUARY 29, 2014 -TUSCALOOSA
Precedes University of Alabama
Business Analytics Symposium
January 30-31, 2014
Tuscaloosa, Alabama



www.informs.org/Build-Your-Career/Analytics-Certification

All sessions are located in the Convention Center.

SUNDAY

■ **SA29**
210A, Level 2
8:00am–8:45am
AnyLogic North America - Multi-Method Modeling in AnyLogic
Scott Hebert, Consulting Engineer, shebert@anylogic.com

Come see the AnyLogic Company give a live demonstration where you will see the only solution that lets you combine agent-based, system dynamics and discrete-event modeling techniques within a single model with one platform. Don't miss your chance to learn more and see how AnyLogic can help your business.

8:45am–9:30am
McGraw-Hill Education - Introducing Practice Operations: Single-Player Game for the Introductory Operations Management Course
Heather A. Kazakoff, heather_kazakoff@mcgraw-hill.com; Thomas Hayward, thomas.hayward@mheducation.com

McGraw-Hill Practice Operations provide a lively, interactive experience that focuses on student learning through trial and error within holistic game play, where students see how the elements of operations and production come together. Highlights the inherently interdisciplinary nature of business by demonstrating that the various functional areas of the company, human resources, manufacturing, accounting, and sales must work together in order to meet company goals. Provides reporting features that make it easy for instructors to assess player performance and decision-making.

■ **SB29**
210A, Level 2
11:00am–11:45am
JMP Software from SAS
Jian Cao, Systems Engineer, jian.cao@jmp.com

JMP® is the SAS® software that links robust statistics with interactive graphics, in memory and on the desktop. JMP is also an analytic hub, integrating with SAS, R, Excel and MATLAB, to provide a point and click user interface. JMP's tools for interactive exploratory data analysis and statistical modeling will be demonstrated. Also reviewed will be new features in JMP 11 including generalized models, repeated measures/mixed models, response screening, uplift, and categorical data.

11:45am–12:30pm
American Optimal Decisions - Portfolio Safeguard (PSG): Advanced Nonlinear Mixed-Integer Optimization Package
Stan Uryasev, Consultant, uryasev@aorda.com

Portfolio Safeguard is an advanced nonlinear mixed-integer optimization package used in risk management, statistics, financial engineering, military, medical and other applications. Design and solve complex optimization problems with built-in functions (maximum, StDev, variance, probability, VaR, CVaR, Drawdown, cardinality, fixed-charge, spline, recourse etc.) See real-life case studies at www.aorda.com/aod/psg.action.

■ **SB39**
Auditorium 3, Level 1
11:00am–11:45am
Numerical Algorithms Group - Mathematical Software to Address Your Business Needs
Brian Spector, Technical Sales Specialist spector@nag.com

Do you need to make your numerical code more efficient and accurate but don't know where to begin? We will demonstrate some of the 1,700 mathematical and statistical functions using the Numerical Algorithms Group (NAG) Library from MATLAB and Excel. Examples covered include optimization, regression, nearest correlation matrix, and more.

11:45am–12:30pm
Sulum Optimization - Optimization for Servers and Cloud Computing at Competitive Prices
Bo Jensen, CEO
bo.jensen@sulumoptimization.com;
Lars Beckmann, lars.beckmann@cloudsolver.net

Sulum Optimization Tools is a high performance optimization engine for solving network, linear, and integer problems. This talk will present the most recent improvements. In particular we will cover our new Cloud Solver and demonstrate how to solve optimization problems on remote servers or in the cloud with easy to manage software tools.

■ **SC29**
210A, Level 2
1:30pm–2:15pm
Palisade Corporation - Avoiding Failure: Using @RISK to Identify, Analyze and Manage Risk More Successfully
Rafael Hartke, Consultant, rhartke@palisade.com

Projects fail. They often fail for a lack of effective planning, either because of excess optimism in terms of time, cost and performance or because of extra work in the plan in terms of scope, resources and unforeseen events. @RISK employs Monte Carlo based simulation to give insight through sophisticated statistical analysis of the various potential outcomes. Understanding range outcomes facilitates effective risk management, prioritizing critical risks and managing expectations.

2:15pm–3:00pm
LINKS Simulations - Exploiting Web Resources for Maximum Teaching and Learning Impact With Integrative Competitive Simulations
Randall G. Chapman, Founder
chapman@LINKS-simulations.com

How can an instructor teach effectively and efficiently with an integrative, large-scale, team-based, competitive business/management simulation? By exploiting the simulation's web-based teaching and learning resources! This presentation explores web-based resources for supporting instructors and their students throughout LINKS simulations events.

■ **SC39**
Auditorium 3, Level 1
1:30pm–2:15pm
MOSEK ApS - On Using MOSEK to Solve Large-Scale Linear and Conic Optimization Problems
Erling D. Andersen, CEO,
e.d.andersen@mosek.com

MOSEK is a tool for solving large scale potentially mixed-integer linear and conic optimization problems. In this demonstration we will introduce MOSEK and demonstrate how to call MOSEK from mainstream languages such as C, MATLAB, Java, .NET and Python.

2:15pm–3:00pm
Ivy Software Inc. - Quantitative Pre-Matriculation Materials for MBA Programs
Rob Holt, Marketing Representative, rob@ivysoftware.com

Ivy Software will present three online courses, Business Math and Statistics, Math and Statistical Concepts, and Excel for MBAs. In addition, Ivy will present Excel for undergraduate business majors. Each course consists of a text and interactive software. The courses are self-paced, online and utilize extensive assessment testing. Topics covered are regression, probability and decision analysis. Our new courses will run on PC, Mac and iOS.

■ **SD29**
210A, Level 2
4:30pm–5:15pm
Artelys - Optimizing Military Attacks on Multi-Commodity SC Networks: Min-Max Problem Solved with Artelys Kalis
Sylvain Mouret, Product Manager, sylvain.mouret@artelys.com

Learn how easy it is to solve general min-max problems arising in adversarial games with Artelys Kalis. Thanks to its hybrid CP/MIP architecture, it is possible to build an efficient branch and bound method specialized for such problems in just a few lines of code. We will demonstrate how Kalis has been embedded in a full-range operational solution based on the Artelys Network Designer GIS visualization platform. This solution is currently used to study supply chain network vulnerabilities with respect to military attacks.

5:15pm-6:00pm
MathWorks - MATLAB: An Environment for Operations Research and Data Analytics
Seth DeLand, Product Manager, Optimization Products, seth.deland@mathworks.com

MATLAB is a platform for analysis, visualization, simulation and optimization. You can access and analyze real-world data and develop customized algorithms that help make better decisions. Join us to see what's new and how MATLAB can help you explore data, develop algorithms, and integrate programs into enterprise applications.

■ **SD39**
Auditorium 3, Level 1
4:30pm–5:15pm
Intaver Institute Inc. - Intaver RiskyProject Software
Lev Virine, Chief of Innovation, Risk Management and Decision Analysis, lvirine@intaver.com

Intaver's RiskyProject is enterprise project risk management and risk analysis software. RiskyProject is used for project and portfolio planning, scheduling, qualitative risk analysis and quantitative analysis using Monte Carlo simulations. The presentation demonstrates RiskyProject software: how to identify and manage project risks, perform risk analysis using Monte Carlo, and interpret the results of analysis.

5:15pm-6:00pm
Oracle - Learn about Oracle Crystal Ball
Michael Franden, Applications Sales, michael.franden@oracle.com

Oracle's Crystal Ball software is a spreadsheet-based software suite for predictive modeling, forecasting, Monte Carlo simulation and optimization. Crystal Ball is used in universities, businesses, and governments worldwide to teach financial risk analysis, valuation, engineering, portfolio allocation, cost estimation, and project management. Join us for an overview of Crystal Ball, its uses and our teaching resources.

MONDAY

■ **MA29**
210A, Level 2
8:00am–8:45am
SAS Global Academic Program - High-Performance Data Mining with SAS Enterprise Miner
André de Waal, Analytical Consultant, andre.dewaal@sas.com

Very large data sets with millions of rows and computationally intensive model fitting requires massively parallel processing to be effective. High-Performance analytics exploits massively parallel processing to reduce dramatically the run time needed for the construction of analytical models. A brief overview of various computing approaches is given. This workshop then highlights the similarities and differences between the High-Performance nodes in SAS Enterprise Miner 12.1 and the classical nodes that have been available for same time in previous versions of Enterprise Miner. A software demonstration is included.

8:45am–9:30am
Forio Online Simulations - Clear and Simple High Performance Technical Computing with Julia
Westely Hennigh, whennigh@forio.com

Julia is a new, high-performance dynamic programming language for technical computing that provides a sophisticated compiler, distributed parallel execution, numerical accuracy, and an extensive mathematical function library. Forio will demo its IDE for Julia that allows users to read, write, edit, and execute their Julia code and includes syntax-highlighting and code-completion.

■ **MB29**
210A, Level 2
11:00am-11:45am
Gurobi Optimization - Gurobi Compute Server, Distributed Tuning Tool and Distributed Concurrent MIP Solver
Zonghao Gu, CTO, gu@gurobi.com

We will present the Gurobi Compute Server, which allows you to seamlessly offload your optimization computations onto one or more dedicated optimization servers. We will also discuss the design and features of Gurobi Compute Server, and how to use it to build and deploy an application locally or in the cloud. Lastly, we will talk about our distributed features based on the Gurobi Compute Server, such as our new distributed automatic parameter tuning tool and distributed concurrent MIP solver.

11:45am-12:30pm
AIMMS (Paragon Decision Technology) – AIMMS for Advanced Optimization
Deanne Zhang, d.zhang@aimms.com; Bobby Nyotta, b.nyotta@aimms.com

This demo will concentrate on how AIMMS can help you solve complicated optimization models using prebuilt building blocks to meet customized requirements. We will demonstrate the AIMMS' Benders Decomposition library for large MIP models and AIMMS' Outer Approximation algorithm for MINLP models. We will also show you how to use the "straight out of the box" tools. These advanced algorithms in AIMMS will give you the power and flexibility to tackle the most complicated problems. More information is available at aimms.com/workshops.

■ **MC29**
210A, Level 2
1:30pm–2:15pm
LINDO Systems, Inc. - Optimization Made Easy
Mark Wiley, mwiley@lindo.com; Gautier Laude, glaude@lindo.com

Learn to quickly build linear, nonlinear, global and integer optimization models; incorporate uncertainty into models; access data in Excel / databases; and create custom optimization applications. See the newest releases of: LINDO API - callable solver engine; LINGO - integrated modeling language and solvers; and What'sBest! - large-scale solver for Excel.

2:15pm–3:00pm
AMPL Optimization, Inc. - New AMPL Interfaces for Enhanced Development and Deployment of Optimization Models
Robert Fourer, 4er@ampl.com

We introduce the new AMPL IDE, which provides an integrated command interpreter and file editor for more convenient optimization model development. Additionally we present details of the first AMPL APIs, which facilitate model deployment by letting your applications invoke many AMPL functions directly, using calls written in popular programming languages.

■ **MD29**
210A, Level 2
4:30pm–5:15pm
SAS - Building and Solving Optimization Models with SAS
Ed Hughes, SAS/OR Product Manager, ed.hughes@sas.com; Rob Pratt, Operations Research R&D Manager, rob.pratt@sas.com

OPTMODEL from SAS provides a modeling environment featuring a powerful and intuitive algebraic optimization modeling language and unified support for building and solving LP, MILP, QP, NLP, and network models. We'll demonstrate OPTMODEL for basic and advanced problems, highlighting its newer capabilities and its support for both standard and customized solution approaches.

5:15pm–6:00pm
Responsive Learning Technologies, Inc. - Online Games to Teach Operations and Supply Chain Management
Sam Wood, President, wood@responsive.net

Learn about online competitive exercises that are used in operations management courses and supply chain management courses to teach topics like capacity management, lead time management, inventory control, supply chain design and logistics. These games are typically used as graded assignments.

tuesday

■ **TA29**
210A, Level 2
8:00am–8:45am
Ziena Optimization LLC - Using the KNITRO Tuner for Improved Performance
Richard Waltz, President, waltz@ziena.com

KNITRO is the premier solver for nonlinear optimization problems. This software demonstration will highlight the new KNITRO Tuner forthcoming in KNITRO 9.0. The KNITRO Tuner will automatically tune and recommend non-default user option settings to obtain the best performance for difficult nonlinear optimization problems. Examples will be provided.

8:45am–9:30am
FICO - Optimization on the FICO Analytic Cloud
Oliver Bastert, oliverbastert@fico.com; Jim Williams

This demo will show you how to turn an optimization model into a full optimization application in minutes. As a second step we will demonstrate how to deploy this application on the FICO Analytic Cloud. Once an optimization model or application is hosted on FICO Analytic Cloud, others can subscribe to them and you can begin generating review with your valuable IP. Based on several examples, we show you how to start with an optimization model, create optimization scenarios, and compare and visually analyze the execution results from your PC or your mobile device.

■ **TB29**
210A, Level 2
11:00am–11:45am
Imagine That, Inc. - ExtendSim Simulation Software
Dave Krahl, Technology Evangelist, davek@extendsim.com; Jim Dailey, Simulation Analyst Process Model Development

Experience the ease at which robust, intuitive models are built with the power tool for simulation - ExtendSim. Use custom interactive model interfaces and hierarchical submodels to rapidly explore simulation concepts and design options. Use ExtendSim to achieve your modeling objectives rapidly and be assured success.

11:45am–12:30pm
GAMS Development Corporation - Model Building and Deployment with GAMS
Steve Dirkse, Director of Optimization, sdirkse@gams.com

We demonstrate many of the capabilities of the GAMS software as we start with a simple optimization model and build it out by adding nonlinear and integer variables to the model and connecting it with a GUI in a sample application.

■ **TC29**
210A, Level 2
1:30pm–2:15pm
Frontline Systems, Inc. - Integrated Data Mining, Simulation and Optimization in Microsoft Excel
Daniel H. Fylstra, President, daniel@solver.com

Analytic Solver Platform in Microsoft Excel has everything you need for forecasting and data mining, Monte Carlo simulation and risk analysis, and conventional and stochastic optimization. See how you can use it to build your own analytic expertise, teach others using leading textbooks, build industrial-scale models, and communicate business results.

2:15pm–3:00pm
Syncopation Software - DPL Products
Tony Manzella, tmanzella@syncopation.com

This demonstration will explore the full range of DPL products. With DPL 8's new Excel add-in interface, performing a quick analysis on a spreadsheet takes just a few clicks, all right in Excel's ribbon (yes, your students will figure this out themselves). Moving beyond the basics, DPL's advanced Fault Trees and flexible objective functions make quick work of tough security problems. Need to make that decision 100 times? DPL's Portfolio version has you covered.

■ **TD29**
210A, Level 2
4:30pm–5:15pm
IBM - Expert Tips and Tricks for Using CPLEX Optimization Studio
Ferenc Katai, IBM ILOG CPLEX Optimization Studio Product Manager,
ferenc.katai@fr.ibm.com,

Learn about the latest innovations in CPLEX Optimization Studio including options for distributed computing. Learn how to make best use of this technology with expert tips and tricks provided by the CPLEX Optimization Studio team.

5:15pm–6:00pm
Maximal Software, Inc. - Deploying Optimization Models on Servers and Mobile Platforms Using MPL OptiMax
Bjarni Kristjansson, President,
bjarni@maximalsoftware.com

The IT industry is currently undergoing a major shift, away from traditional standalone applications, to new platforms such as servers, clouds, tablet, and mobile phones. In this software tutorial, we will demonstrate a new server-based version of the MPL OptiMax Component Library, which makes implementing real-world optimization applications a relatively quick and easy process. We will take you through all the steps of implementing optimization projects, including formulating the model, integrating it seamlessly with data in different formats, and then finally deploying the project on a server for servicing both web and mobile clients, using standard programming languages, such as CSharp, Visual Basic, C/C++, or Python.

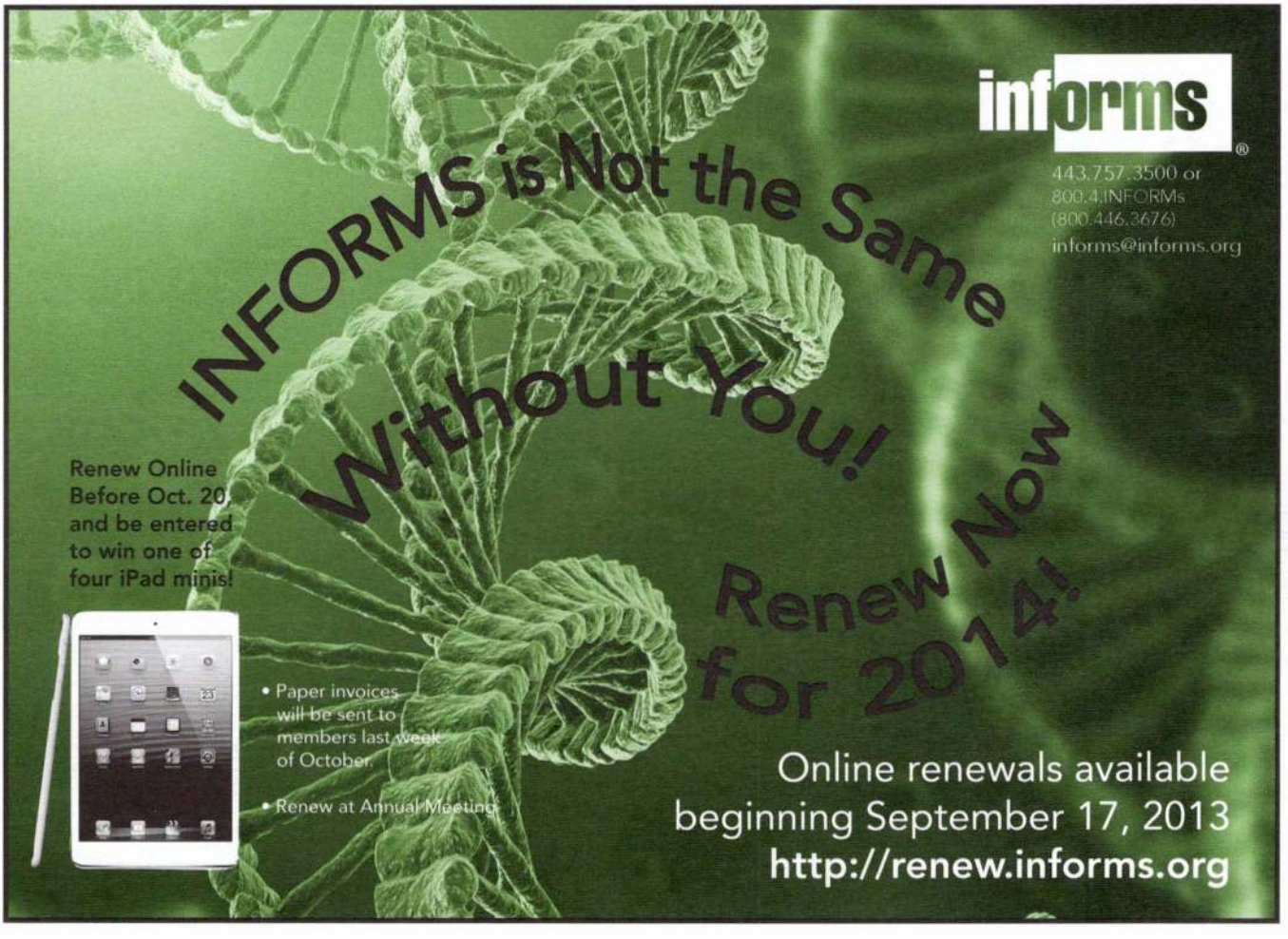
Wednesday

■ **WA29**
210A, Level 2
8:00am–8:45am
BizSimz - Flexible Educational Simulations
Chris Huston, Founder,
chris.huston.t10@gmail.com

An overview of BizSimz simulations (FactorySim, CapacitySim, RmSim, FlexCap, SIP, BottleneckSim and QueueSim), discussing the options available for customizing the learning experience. See a demonstration of how to run the competitive simulations during a class session.

8:45am-9:30pm
Creating Compelling Decision Support Tools and Dashboards
Chaitanya Sagar, CEO
cs@perceptive-analytics.com

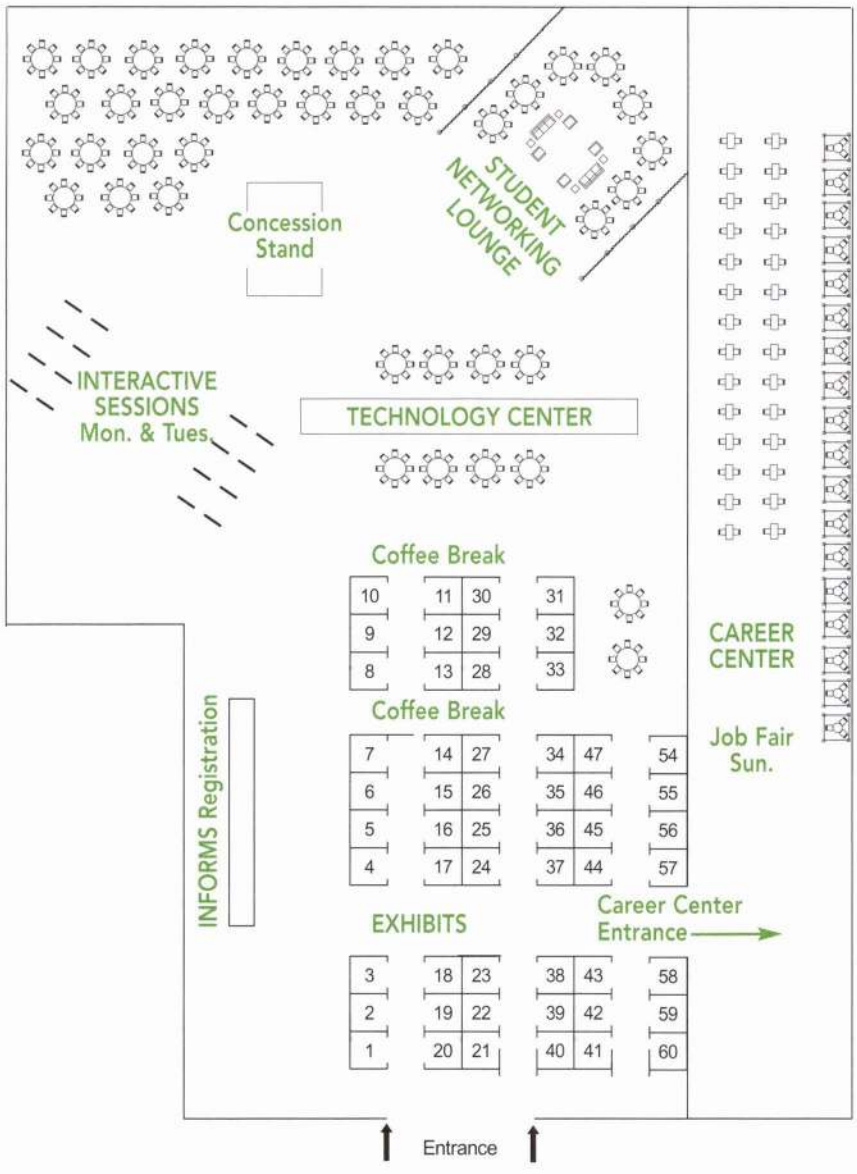
As important as a decision-support tool is the design of the tool, the ability to make the tool communicate with the executive decision maker and give the power to run what-if analyses can amplify the tool's actual and perceived utility. This tutorial helps you be awesome at creating clinching decision support tools.



exhibits open

Sun., Oct. 6	12:00pm-5:00pm
	7:30pm-9:00pm
	(Welcome Reception)
Mon., Oct. 7	9:00am-5:00pm
Tues., Oct. 8	9:00am-5:00pm
Wed., Oct. 9	9:00am-1:00pm

convention center exhibit hall



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500 108th Ave. NE, Ste. 1780
Bellevue, WA 98004
www.aimms.com

The AIMMS and AIMMS PRO Optimization Platform allow businesses to approach complex situations with facts and evidence, leading to better decision making. This can produce higher revenues, increased sustainability, greater efficiencies, and customer satisfaction. AIMMS quickly and effectively delivers custom solutions that will impact every level of your organization. If you're ready to approach game-changing optimization for your business or organization, stop by our booth.

American Optimal Decisions **#25**
5214 SW 91st Way, Ste. 130
Gainesville, FL 32608
www.aorda.com

American Optimal Decisions provides consulting services and software solutions in advanced statistics, optimization and risk management. The main software product is Portfolio Safeguard (PSG), an advanced nonlinear mixed-integer optimization package. Use simple codes for sophisticated optimization problems, calling non-linear functions without additional programming. Function groups: linear, nonlinear, utilities, cardinality, average, VaR, CVaR, and more. AOD provides consulting in various engineering areas involving statistics and optimization. See case studies at www.aorda.com/aod/psg.action.

AMPL Optimization, Inc. **#33**
900 Sierra Pl. SE
Albuquerque, NM 87108-3379
www.ampl.com

AMPL Optimization develops and supports the AMPL modeling language, a powerful and natural tool for creating and managing the large, complex optimization problems that arise in numerous applications. AMPL is notable for supporting a broad range of linear and nonlinear problem formulations and a large selection of popular large-scale solvers.

AnyLogic North America **#8**
53 Frontage Rd., Ste. 115
Hampton, NJ 08833
www.anylogic.com

AnyLogic is the only simulation tool that supports discrete event, agent based, and system dynamics modeling, providing solutions to complex, business challenges. We are excited to announce the upcoming launch of AnyLogic 7! Stay tuned... Although very intuitive, our consultants are available, through every step of the modeling process.

Artelys #31
150 N. Michigan Ave., Ste. 800
Chicago, IL 60601
www.artelys.com

Artelys, an optimization and analytics company, is dedicated to providing sound decision-making through technology, O.R. and statistics. Artelys develops, distributes, and supports a comprehensive portfolio of efficient and robust tools, such as Artelys Kalis, FICO Xpress Optimization suite, KNITRO and AMPL. Artelys has been also successful in solving wide varieties of industrial problems using its optimization tools and development platform, Artelys Crystal. Artelys has been successful in delivering 100+ efficient solutions to the most complex business problems.

BizSimz #29
8 Sachem Circle, #5
West Lebanon, NH 03784
www.bizsimz.com

Online business simulations to allow users to learn about planning & scheduling, pricing, revenue management, capacity expansion, variability, queuing theory and more. Some simulations have users compete against each other while others have users explore business concepts through a variety of scenarios. Simulations are highly customizable to suit different educational goals.

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www.coin-or.org

The Computational Infrastructure for Operations Research publishes high quality, free, open source tools for O.R. professionals and students, suitable for commercial, educational and personal use. COIN-OR is the place to go when you need a "white box" for algorithm research and development. COIN-OR is a strategic partner of the INFORMS Computing Society.

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270 North Main St., Ste. A
Alpine, UT 84004
www.dominioninsurance.com

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Dynamic Ideas #54
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IFORS 2014 #46
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The International Federation of Operational Research Societies is an umbrella organization comprising the national OR societies of over 45 countries from four geographical regions: Asia Pacific, Europe, North America and South America. The IFORS mission is to promote O.R. as an academic discipline and a profession. The IFORS Triennial Conference will be held July 13-18th, 2014, in Barcelona Spain. General Chair is Elena Fernández, e.fernandez@upc.edu, and Program Chair is Stefan Nickel, stefan.nickel@kit.edu.

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Maximal Software is giving away a FREE development license of the MPL Modeling System! To sign up for your free copy, please visit us at our booth anytime, and attend our software demo, Tuesday at 5:15pm. We will present the server-based version of the MPL OptiMax Component Library, which makes implementing and deploying real-world optimization applications for servers, clouds, and mobile platforms, a relatively quick and easy process, using standard programming languages.

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MOSEK ApS #3
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MOSEK ApS provides optimization software which help our clients to make better decisions. Our customer base consists of financial institutions and companies, engineering and software vendors, among others. MOSEK ApS was established in 1997 by Erling D. Andersen and Knud D. Andersen. It specializes in creating advanced software for solution of mathematical optimization problems. In particular, the company focuses on solution of large-scale linear, quadratic and conic optimization problems.

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Palisade Corporation is the maker of the market leading risk and decision analysis software @RISK and the DecisionTools® Suite. Virtually all Palisade software adds in to Microsoft Excel, ensuring flexibility, ease-of-use, and broad appeal across a wide range of industry sectors. Its flagship product, @RISK, debuted in 1987 and performs risk analysis using Monte Carlo simulation. With an estimated 150,000 users, Palisade software can be found in more than 100 countries and has been translated into six languages.

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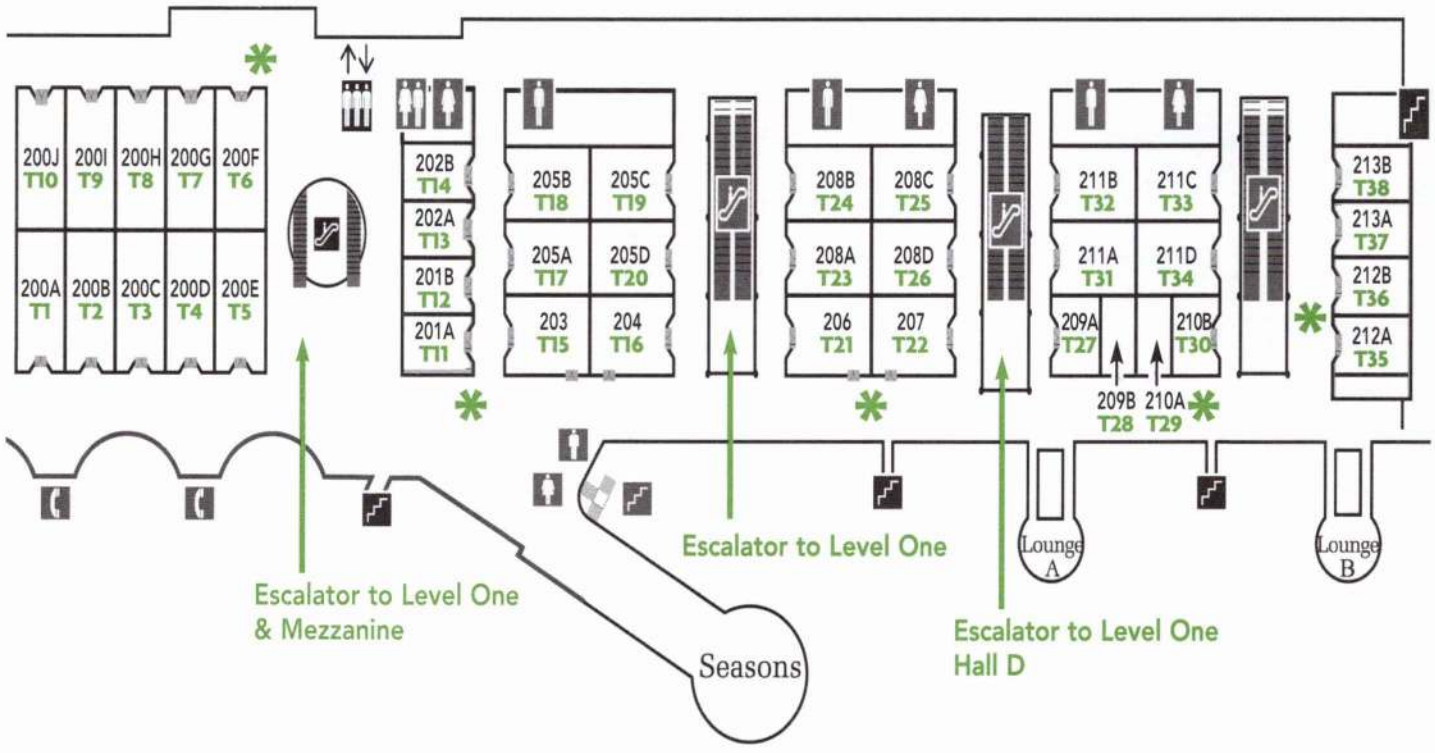
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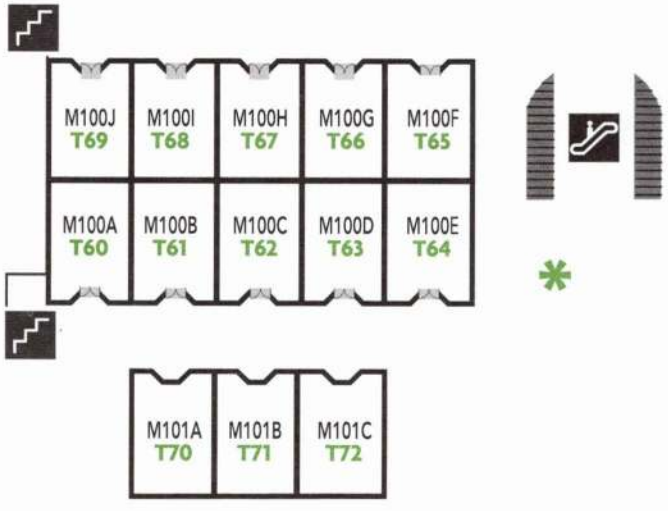
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LEVEL TWO – TRACKS 1-38



MEZZANINE LEVEL – TRACKS 60-72

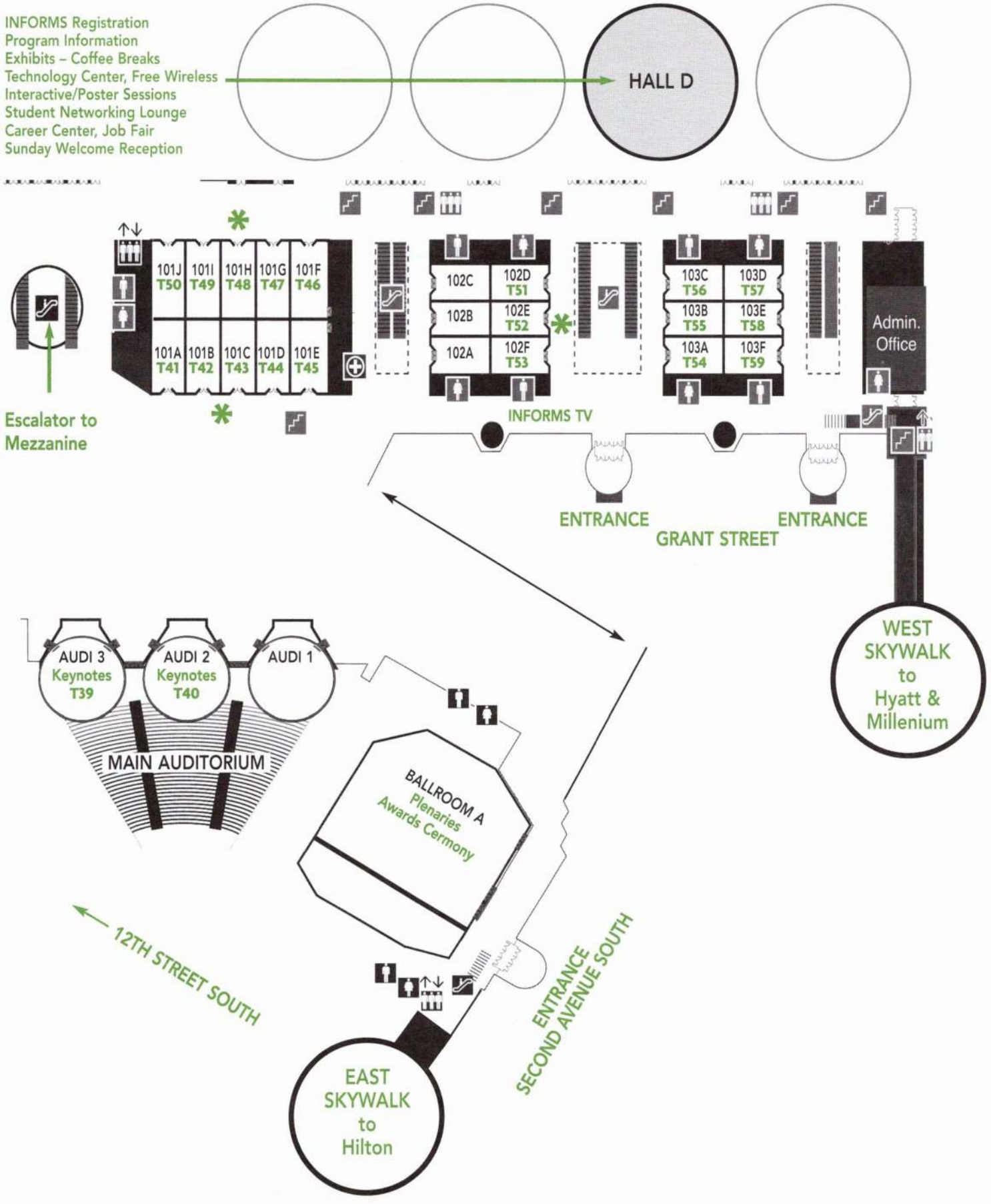


LEGEND

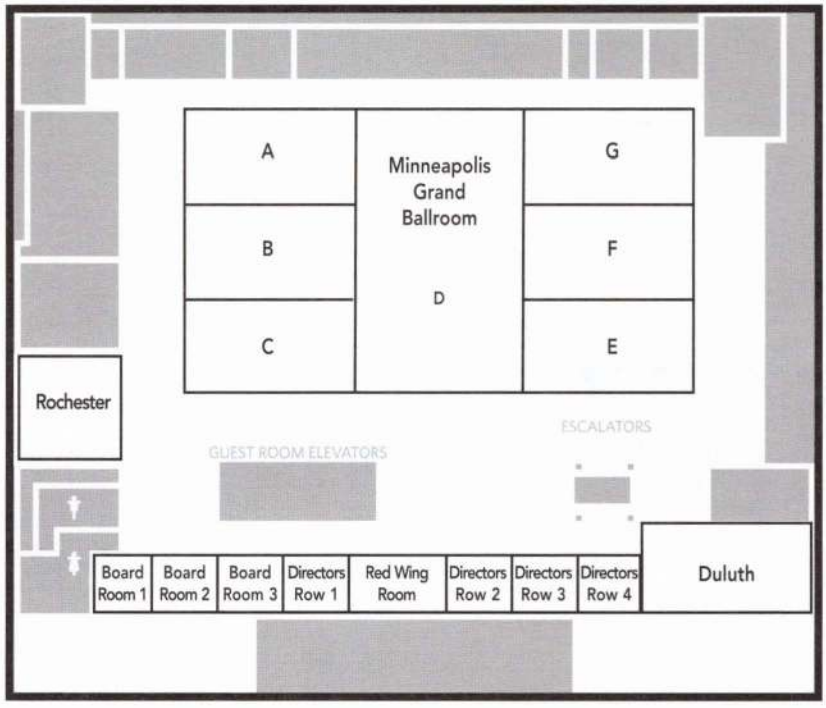
- Restrooms
- House Phone
- Escalator (All Levels)
- Elevator (All Levels)
- Stairs (Levels 1 & 2)
- Emergency Stairs

MAPS NOT TO SCALE

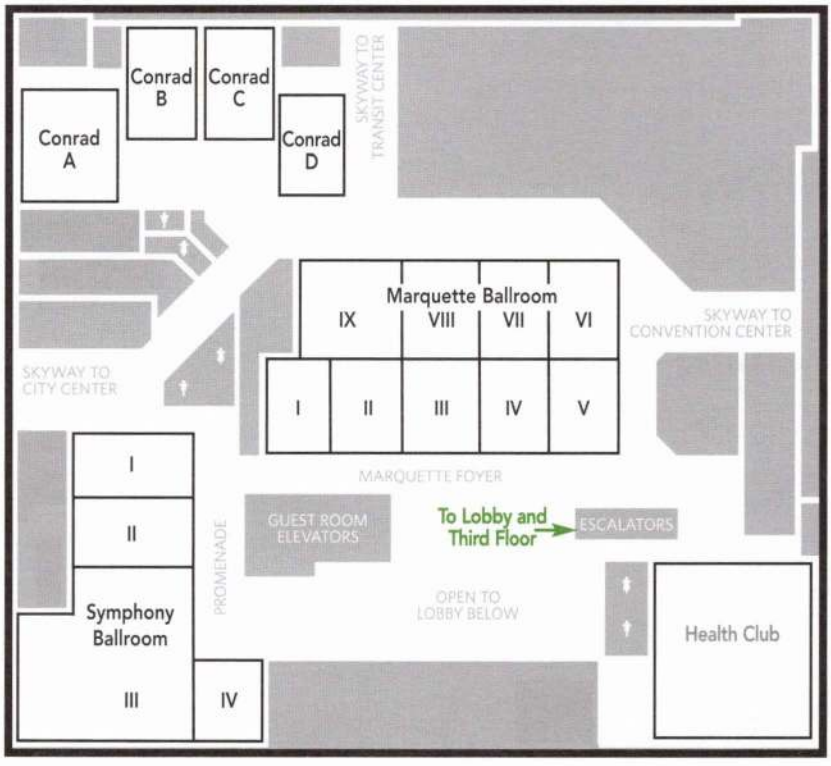
LEVEL ONE – TRACKS 39-59



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Hotels

- A aloft Minneapolis
- B Best Western Normandy Inn and Suites
- C Courtyard Minneapolis Downtown
- D Crowne Plaza Northstar Downtown Minneapolis
- E The Depot Renaissance Minneapolis Hotel
- F DoubleTree Suites by Hilton Minneapolis
- G The Grand Hotel
- H Graves 601 Wyndham Grand
- I Hilton Garden Inn
- J Hilton Minneapolis
- K Holiday Inn Express Hotel & Suites
- L Hotel Ivy - The Luxury Collection
- M Hotel Minneapolis (The)
- N Hyatt Place Downtown
- O Hyatt Regency Minneapolis
- P LeMeridien Chambers Minneapolis
- Q Marquette (The)
- R Marriott Minneapolis City Center Hotel
- S Millennium Hotel Minneapolis
- T Radisson Plaza Hotel Minneapolis
- U Residence Inn by Marriott
- V W Hotel - The Foshay
- W Westin Minneapolis (The)

Minneapolis
City by Nature

Track	Room	SA 8:00-9:30	Plenary 10:00–10:50	SB 11:00-12:30	SC 1:30-3:00	Plenary 3:10-4:00	SD 4:30-6:00
1	L2-200A	Optimization in Finance		Optimization in Finance	Optimization in Finance		Optimization in Finance
2	L2-200B	Opt.-Computational Opt. & Software		Opt.-Computational Opt. & Software	Opt.-Computational Opt. & Software		Opt.-Computational Opt. & Software
3	L2-200C	Opt.-Global Opt. Mixed-Integer Nonlinear Prog		Opt.-Global Opt. Mixed-Integer Nonlinear Prog	Opt.-Global Opt. Mixed-Integer Nonlinear Prog		Opt.-Global Opt. Mixed-Integer Nonlinear Prog
4	L2-200D	Opt.-Integer Programming		Opt.-Integer Programming	Opt.-Integer Programming		Opt.-Integer Programming
5	L2-200E	Opt.-Networks		Opt.-Networks	Opt.-Networks		Opt.-Networks
6	L2-200F	Opt.-Linear Prog. & Complementarity	**Welcome & Plenary**	Opt.-Linear Prog. & Complementarity	Opt.-Linear Prog. & Complementarity	**Introduction & Plenary**	Opt.-Linear Prog. & Complementarity
7	L2-200G	Opt.-Stoch. Programming		Opt.-Stoch. Programming	Opt.-Stoch. Prog. & Climate Change		Opt.-Stoch. Programming
8	L2-200H	Computing Society	**Welcome: Anne Robinson President INFORMS**	Computing Society	Computing Society	**Introduction: Robert Haight, USDA Forest Service General Chair INFORMS Annual Meeting**	Computing Society
9	L2-200I	Analytics Section		Analytics Section	Analytics Section		Analytics Section
10	L2-200J	INFORM-ED		INFORM-ED	INFORM-ED		INFORMS 2013 Prize
11	L2-201A	Telecommunications		Telecommunications	Telecommunications		Telecommunications & INFORM-ED
12	L2-201B	Organization Science	**Plenary: Pavel Kabát Benefits of Systems Science for Policy Support**	Organization Science	Nicholson Student Paper Prize		Nicholson Student Paper Prize
13	L2-202A	New Product Development		New Product Development	New Product Development		New Product Development
14	L2-202B	Managing Disruptions in SC		Junior Faculty Interest Group	Managing Disruptions in SC		Managing Disruptions in SC
15	L2-203	Service Science		Service Science	Service Science	**Plenary: Anne Robinson Advanced Analytics: Empowering Operations Research**	Service Science
16	L2-204	Health Applications		Health Applications	Health Applications		Health Applications
17	L2-205A	Service Science		Service Science	Service Science		Service Science
18	L2-205B	Service Science	**Ballroom A Level 1**	Service Science	Service Science	**Ballroom A Level 1**	Service Science
19	L2-205C	Applied Probability		Applied Probability	Applied Probability		Applied Probability
20	L2-205D	Applied Probability		Applied Probability	Applied Probability		Applied Probability
21	L2-206	Health Applications		Health Applications	Health Applications		Health Applications
22	L2-207	Healthcare Systems/Informatics		Healthcare Systems/Informatics	Healthcare Systems/Informatics		Healthcare Systems/Informatics
23	L2-208A	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing
24	L2-208B	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing
25	L2-208C	Auctions		Auctions	Auctions		Auctions
26	L2-208D	Location Analysis		Location Analysis	Location Analysis		Location Analysis
27	L2-209A	Military Applications		Military Applications	Military Applications		Military Applications
28	L2-209B	Humanitarian Logistics		Doing Good with Good OR	Doing Good with Good OR		Data Envelopment Analysis
29	L2-210A	AnyLogic & McGraw-Hill Education		JMP & American Optimal Decisions	Palisade & LINKS Simulations		Artelys & MathWorks
30	L2-210B	Workforce Engineering & Mgt.		Workforce Engineering & Mgt.	Workforce Engineering & Mgt.		Workforce Engineering & Mgt.
31	L2-211A	Financial Services		Financial Services	Financial Services		Financial Services
32	L2-211B	Technology Mgt.		Technology Mgt.	Technology Mgt.		Technology Mgt. & NPD
33	L2-211C	Railway Applications		Railway Applications	Railway Applications		Railway Applications
34	L2-211D	Simulation Society		Simulation Society	Simulation Society		Simulation Society
35	L2-212A	E-Business		E-Business	E-Business		E-Business
36	L2-212B	Public Programs, Service & Needs		SPPSN/DAS	SPPSN		SPPSN
37	L2-213A	Scheduling & Project Mgt.		Scheduling & Project Mgt.	Scheduling & Project Mgt.		Scheduling & Project Mgt.
38	L2-213B	Multiple Criteria Decision Making		Multiple Criteria Decision Making	Multiple Criteria Decision Making		Multiple Criteria Decision Making

Track	Room	SA 8:00-9:30	Plenary 10:00–10:50	SB 11:00-12:30	SC 1:30-3:00	Plenary 3:10-4:00	SD 4:30-6:00
39	L1-Auditorium 3	Junior Faculty Interest Group		Numerical Algorithms Group & Sulum Opt.	MOSEK & Ivy Software		Intaver Institute & Oracle
40	L1-Auditorium 2	Auctions		Auctions	Auctions		Auctions
41	L1-101A	Mfg. & Service Operations Mgt.		MSOM	MSOM		MSOM
42	L1-101B	Mfg. & Service Operations Mgt.		MSOM	MSOM		MSOM
43	L1-101C	Mfg. & Service Operations Mgt.		MSOM	MSOM		MSOM
44	L1-101D	Mfg. & Service Operations Mgt.- SC		MSOM-Supply Chain	MSOM- Supply Chain		MSOM- Supply Chain
45	L1-101E	MSOM-Sustainable Operations		MSOM-Sustainable Operations	MSOM-Sustainable Operations		MSOM-Sustainable Operations
46	L1-101F	MSOM-iFORM		MSOM-iFORM	MSOM-iFORM		MSOM-iFORM
47	L1-101G	MSOM-Service Operations		MSOM-Service Operations	MSOM-Service Operations		MSOM-Service Operations
48	L1-101H	Behavioral Operations Mgt.		Behavioral Operations Mgt.	Behavioral Operations Mgt.		Behavioral Operations Mgt.
49	L1-101I	Tutorial-David Gamarnik		Tutorial-Xin Chen	Tutorial-Omar Besbes		Tutorial-Vivek Farias
50	L1-101J	Climate Change & OR		Climate Change & OR	Climate Change & OR		Climate Change & OR
51	L1-102D	TSL-Urban Transportation		TSL-Urban Transportation	TSL-Urban Transportation		TSL-Urban Transportation
52	L1-102E	TSL-Freight Transport. & Logistics		TSL-Freight Transport. & Logistics	TSL-Freight Transport. & Logistics		TSL-Freight Transport. & Logistics
53	L1-102F	TSL-Facility Logistics		TSL-Facility Logistics	TSL-Facility Logistics		TSL-Facility Logistics
54	L1-103A	TSL-Intelligent Transport. Systems (ITS)		TSL-ITS	TSL-ITS		TSL-ITS
55	L1-103B	Transportation Science & Logistics		Transportation Science & Logistics	Transportation Science & Logistics		Transportation Science & Logistics
56	L1-103C	ENRE-Energy Climate Change & OR		ENRE-Energy	ENRE-Energy		ENRE-Energy
57	L1-103D	Energy, Natural Res. & Env.-Energy		ENRE-Energy	ENRE-Energy		ENRE-Energy
58	L1-103E	ENRE-Forestry/Mining		ENRE-Forestry/Mining	ENRE-Forestry/Mining		ENRE-Forestry/Mining
59	L1-103F	ENRE-Environment & Sustainability		ENRE-Environment & Sustainability	ENRE-Environment & Sustainability		ENRE-Environment & Sustainability
60	Mezz-M100A	Data Mining		Data Mining- Best Student Comp.	Data Mining		Data Mining
61	Mezz-M100B	Data Mining		Data Mining	Data Mining & HAS		QSR
62	Mezz-M100C	Quality, Statistics & Reliability		QSR	QSR		QSR
63	Mezz-M100D	Quality, Statistics & Reliability		QSR	QSR		QSR
64	Mezz-M100E	Quality, Statistics & Reliability		QSR	QSR		QSR
65	Mezz-M100F	Artificial Intelligence		Artificial Intelligence	Artificial Intelligence		Artificial Intelligence
66	Mezz-M100G	Information Systems		Information Systems	Information Systems		Information Systems
67	Mezz-M100H	Decision Analysis		Decision Analysis	Decision Analysis		Decision Analysis
68	Mezz-M100I	Decision Analysis		Decision Analysis	Decision Analysis		Decision Analysis
69	Mezz-M100J	Decision Analysis		Decision Analysis	Stochastic Decision Analysis		Decision Analysis
70	Mezz-M101A	Aviation Applications		Aviation Applications	Aviation Applications		Aviation Applications
71	Mezz-M101B	Aviation Applications		Aviation Applications	Aviation Applications		No Session
72	Mezz-M101C	Topics in OR/MS		OR/MS in Economics	INFORMS Communities		INFORMS Communities

Interactive Session, 12:30pm- 2:30pm, Exhibit Hall D

Track	Room	MA 8:00-9:30	Plenary 10:00–10:50	MB 11:00-12:30	MC 1:30-3:00	Plenary 3:10-4:00	MD 4:30-6:00
1	L2-200A	Optimization, Spatial Analytics & GIS		Optimization, Spatial Analytics & GIS	Optimization, Spatial Analytics & GIS		No Session
2	L2-200B	Opt.-Computational Opt. & Software		Opt.-Computational Opt. & Software	Optimization		Opt.-Computational Opt. & Software
3	L2-200C	Opt.-Global Opt. Mixed-Integer Nonlinear Prog		Opt.-Global Opt. Mixed-Integer Nonlinear Prog	Opt.-Global Opt. Mixed-Integer Nonlinear Prog		Opt.-Global Opt. Mixed-Integer Nonlinear Prog
4	L2-200D	Opt.-Integer Programming		Opt.-Integer Programming	Opt.-Integer Programming		Opt.-Integer Programming
5	L2-200E	Opt.-Networks		Opt.-Networks	Opt.-Networks		Opt.-Networks
6	L2-200F	Opt.-Linear Prog. & Complementarity	**Plenary Omega Rho Lawrence M. Wein Data-Driven Operations Research Analyses in the Public Sector**	Opt.-Linear Prog. & Complementarity	Opt.-Linear Prog. & Complementarity	**Keynote Edelman Reprise 2013 Winner Delta Programme: Economically Efficient Standards to Protect the Netherlands Against Flooding**	Opt.-Networks
7	L2-200G	Opt.-Stochastic Programming		Opt.-Stochastic Programming	Opt.-Stochastic Programming		Opt.-Stochastic Programming
8	L2-200H	Computing Society		Computing Society	Computing Society		Computing Society
9	L2-200I	Analytics Section		Analytics Section	Analytics Section		Analytics Section
10	L2-200J	Analytics Section		CPMS, The Practice Section	CPMS, The Practice Section		CPMS, The Practice Section
11	L2-201A	Junior Faculty Interest Group		In Memoriam: Saul Gass	Computing Society		Junior Faculty Interest Group
12	L2-201B	SpORts		SpORts	SpORts		SpORts
13	L2-202A	New Product Development		New Product Development	New Product Development		New Product Development
14	L2-202B	Managing Disruptions in Supply Chain	**Ballroom A Level 1**	Managing Disruptions in SC	Managing Disruptions in SC	**Auditorium 2 Level 1**	Supply Chain
15	L2-203	Service Science		Service Science	Service Science		Service Science
16	L2-204	Health Applications		Health Applications	Health Applications		Health Applications
17	L2-205A	Service Science		Service Science	Service Science		Service Science
18	L2-205B	Service Science		Service Science	Service Science		Service Science
19	L2-205C	Applied Probability		Applied Probability	Applied Probability	**Keynote Mark von Oven The Physics of the Target Guest**	Applied Probability
20	L2-205D	Applied Probability		Applied Probability	Applied Probability		Applied Probability
21	L2-206	Health Applications		Health Applications	Health Applications		Health Applications & SPPSN
22	L2-207	Healthcare Systems/Informatics		Healthcare Systems/Informatics	George B. Dantzig Dissertation Award		International Activities Committee
23	L2-208A	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing	**Auditorium 3 Level 1**	Revenue Mgt. & Pricing
24	L2-208B	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing
25	L2-208C	Auctions		Auctions	Auctions		Auctions
26	L2-208D	Location Analysis		Location Analysis	Location Analysis		Location Analysis
27	L2-209A	Military Applications		Military Applications	Military Applications		Military Applications
28	L2-209B	Data Envelopment Analysis		Data Envelopment Analysis	Data Envelopment Analysis		Data Envelopment Analysis
29	L2-210A	SAS Academic & Forio Simulations		Gurobi Optimization & AIMMS	LINDO Systems & AMPL		SAS & Responsive Learning Tech.
30	L2-210B	Workforce Engineering & Mgt.		No Session	Industrial Applications		Optimization Methodologies
31	L2-211A	Financial Services		Women in OR/MS	Women in OR/MS		Spreadsheet Productivity Interest Grp.
32	L2-211B	Technology Mgt.		Technology Mgt.	Technology Mgt.		Technology Mgt.
33	L2-211C	Railway Applications		Railway Applications	Railway Applications		Homeland Security/Defense
34	L2-211D	Simulation Society		Simulation Society & QSR	Financial Services		In Memoriam: Saul Gass
35	L2-212A	E-Business		E-Business	E-Business		E-Business
36	L2-212B	Public Programs, Service & Needs		Public Programs, Service & Needs	Public Prog., Service & Needs /HAS		Public Programs, Service & Needs
37	L2-213A	Scheduling & Project Mgt.		Scheduling & Project Mgt.	Scheduling & Project Mgt.		Scheduling & Project Mgt.
38	L2-213B	Multiple Criteria Decision Making		Multiple Criteria Decision Making	Multiple Criteria Decision Making		Multiple Criteria Decision Making
39	L1-Auditorium 3	Daniel H. Wagner Prize		Daniel H. Wagner Prize	Daniel H. Wagner Prize		TSL-Freight Transportation & Logistics

Track	Room	MA 8:00-9:30	Plenary 10:00–10:50	MB 11:00-12:30	MC 1:30-3:00	Plenary 3:10-4:00	MD 4:30-6:00
40	L1-Auditorium 2	No Session		OR as a Catalyst for Engineering Challenges	No Session		OR as a Catalyst for for Engineering Challenges
41	L1-101A	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.
42	L1-101B	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.
43	L1-101C	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.
44	L1-101D	Mfg. & Service Operations Mgt.- SC		INFORMS Career Center	INFORMS Career Center		MSOM-Supply Chain
45	L1-101E	MSOM-Healthcare Operations		MSOM-Healthcare Operations	Aviation Applications		MSOM-Sustainable Operations
46	L1-101F	MSOM-iFORM		MSOM-iFORM	MSOM-iFORM		MSOM-iFORM
47	L1-101G	MSOM-Service Ops.		MSOM-Service Operations	MSOM-Service Operations		MSOM-Service Operations
48	L1-101H	Behavioral Operations Mgt.		Behavioral Operations Mgt.	INFORMS Communities		INFORMS Communities
49	L1-101I	Tutorial-Andrzej Ruszczynski		Tutorial-Hande Benson	Tutorial-Xin Guo		Tutorial-Steve Alpern
50	L1-101J	Climate Change & OR		Climate Change & OR	Energy		Energy
51	L1-102D	TSL-Urban Transportation		TSL-Urban Transportation	TSL-Urban Transportation		TSL-Urban Transportation
52	L1-102E	TSL-Freight Transportation & Logistics		TSL-Freight Transportation & Logistics	TSL-Freight Transportation & Logistics		TSL-Freight Transportation & Logistics
53	L1-102F	No Session		TSL- Facility Logistics	TSL- Facility Logistics		TSL- Freight Transportation & Logistics
54	L1-103A	TSL-Intelligent Transport. Systems (ITS)		TSL-ITS	TSL-ITS		TSL-ITS
55	L1-103B	Transportation Science & Logistics		Transportation Science & Logistics	Transportation Science & Logistics		Transportation Science & Logistics
56	L1-103C	Energy, Natural Res. & Env.-Energy		Data Mining	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy
57	L1-103D	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy
58	L1-103E	ENRE-Forestry/Mining		ENRE-Forestry/Mining	ENRE-Energy		Energy, Natural Res. & Env.-Energy
59	L1-103F	ENRE-Environment		ENRE-Environment & Sustainability	ENRE-Environment & Sustainability		ENRE-Environment & Sustainability
60	Mezz-M100A	Data Mining		Data Mining	Data Mining		Data Mining
61	Mezz-M100B	Data Mining		Data Mining	Data Mining		Data Mining
62	Mezz-M100C	QSR -Student Comp.		QSR	QSR		QSR
63	Mezz-M100D	Quality, Statistics & Reliability		QSR	QSR		QSR
64	Mezz-M100E	Quality, Statistics & Reliability		QSR	QSR		Decision Support
65	Mezz-M100F	Artificial Intelligence		Social Media Analytics	Social Media Analytics		Social Media Analytics
66	Mezz-M100G	Information Systems		Information Systems	Information Systems		Information Systems
67	Mezz-M100H	Decision Analysis		Decision Analysis	Decision Analysis		Decision Analysis
68	Mezz-M100I	Decision Analysis		Decision Analysis	Decision Analysis		Decision Analysis
69	Mezz-M100J	Decision Analysis		Decision Analysis	Decision Analysis		Decision Analysis
70	Mezz-M101A	Aviation Applications		Aviation Applications	Aviation Applications		Aviation Applications & TSL
71	Mezz-M101B	Aviation Applications		Aviation Applications	Aviation Applications		Aviation Applications
72	Mezz-M101C	Risk Mgt.		Risk Mgt.	Risk Mgt.		Risk Mgt.

Interactive Session, 12:30pm- 2:30pm, Exhibit Hall D

Track	Room	TA 8:00-9:30	Plenary 10:00–10:50	TB 11:00-12:30	TC 1:30-3:00	Plenary 3:10-4:00	TD 4:30-6:00
1	L2-200A	Optimization in Finance		Optimization in Finance	Optimization in Finance		Optimization in Finance
2	L2-200B	Optimization-Nonlinear Programming		Optimization-Nonlinear Programming	Optimization-Nonlinear Programming		Optimization-Nonlinear Programming
3	L2-200C	Opt.-Global Opt. & Mixed-Integer Nonlinear Prog		Opt.-Global Opt. & Mixed-Integer Nonlinear Prog	Opt.-Global Opt. & Mixed-Integer Nonlinear Prog		Opt.-Global Opt. &. Mixed-Integer Nonlinear Prog
4	L2-200D	Opt.-Integer Programming		Opt.-Integer Programming	Opt.-Integer Programming		Opt.-Integer Programming
5	L2-200E	Optimization-Networks		Optimization-Networks	Opt.-Stochastic Programming		Opt.-Stochastic Programming
6	L2-200F	Optimization-Networks	Plenary Dimitris Bertsimas Health Care Analytics	Optimization-Networks	Optimization-Networks	Keynote Daniel H. Wagner 2013 Prize Winner	Optimization-Networks
7	L2-200G	Opt.-Stochastic Programming		Opt.-Stochastic Programming	Opt.-Stochastic Programming		Opt.-Stochastic Programming
8	L2-200H	Computing Society		Computing Society	Computing Society		Computing Society
9	L2-200I	Analytics Section		Analytics Section	Analytics Section	Auditorium 2 Level 1	Analytics Section
10	L2-200J	CPMS, The Practice Section		Managing Disruptions in SC	INFORM-ED		INFORM-ED/Analytics
11	L2-201A	Minority Issues	Ballroom A Level 1	Minority Issues	Minority Issues		Women in OR/MS
12	L2-201B	SpORts		KINFORMS	INFORMS Undergraduate OR Prize		Opt.-Stochastic Programming
13	L2-202A	New Product Development		New Product Development	New Product Development		New Product Development
14	L2-202B	International Activities Committee		Location Analysis	International Activities Committee	Keynote IFORS Lecture Pascal Van Hentenryck Computational Disaster Management: The Role of OR/MS	OR Practice
15	L2-203	Service Science- Student Paper Finalist		Service Science	Service Science		Service Science
16	L2-204	Health Applications		Health Applications	Health Applications		Health Applications
17	L2-205A	Service Science		Service Science	Service Science		Service Science
18	L2-205B	Service Science		Service Science	Service Science		Tutorials- Diwakar Gupta
19	L2-205C	Applied Probability		Applied Probability	Applied Probability		Applied Probability
20	L2-205D	Applied Probability		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing
21	L2-206	Health Applications		Health Applications	Health Applications	Auditorium 3 Level 1	Health Applications
22	L2-207	Disease Progression		Disease Progression	Disease Progression		Healthcare
23	L2-208A	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing
24	L2-208B	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing
25	L2-208C	Auctions		Auctions	Auctions		Auctions
26	L2-208D	Location Analysis		Location Analysis	Location Analysis		Location Analysis
27	L2-209A	Military Applications		Military Applications	Inventory Mgt.		Inventory Mgt.
28	L2-209B	Data Envelopment Analysis		Cloud Computing	Cloud Computing		Cloud Computing
29	L2-210A	Ziena Optimization & FICO		Imagine That & GAMS	Frontline Systems & Syncopation Software		IBM & Maximal Software
30	L2-210B	Combinatorial Optimization		Continuous Optimization	Convex Optimization		Optimization with Metaheuristics
31	L2-211A	Financial Services		Financial Services	Financial Services		Financial Services
32	L2-211B	Technology Mgt.		Technology Mgt.	Technology Mgt.		Technology Mgt.
33	L2-211C	Homeland Security/Defense		Homeland Security/Defense	Homeland Security/Defense		Homeland Security/Defense
34	L2-211D	Simulation Society & QSR		Simulation Society	Simulation Society		Simulation Society
35	L2-212A	E-Business		E-Business	E-Business		E-Business
36	L2-212B	Public Programs, Service & Needs		Public Programs, Service & Needs	Public Programs, Service & Needs		Healthcare
37	L2-213A	Scheduling & Project Mgt.		Scheduling & Project Mgt.	Scheduling & Project Mgt.		Scheduling & Project Mgt.

Track	Room	TA 8:00-9:30	Plenary 10:00–10:50	TB 11:00-12:30	TC 1:30-3:00	Plenary 3:10-4:00	TD 4:30-6:00
38	L2-213B	Multiple Criteria Decision Making		Multicriteria Opt. & Decision Making	Supply Chain		Supply Chain
39	L1-Auditorium 3	Railway Applications		Railway Applications	Railway Applications &TSL		Railway Applications
40	L1-Auditorium 2	No Session		TSL Dissertation	TSL- Intelligent Transport. Sys. (ITS)		Mfg. & Service Operations Mgt.
41	L1-101A	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	MSOM- Behavioral Op. Mgt.		Mfg. & Service Operations Mgt.
42	L1-101B	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.
43	L1-101C	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.
44	L1-101D	Mfg. & Service Operations Mgt.-SC		Mfg. & Service Operations Mgt.-SC	Mfg. & Service Operations Mgt.-SC		Mfg. & Service Operations Mgt.-SC
45	L1-101E	MSOM-Healthcare Operations		MSOM-Healthcare Operations	MSOM-Healthcare Operations		MSOM-Healthcare Operations
46	L1-101F	MSOM-iFORM		MSOM-iFORM	MSOM-iFORM		Sustainability & Environmental Ops.
47	L1-101G	MSOM-Service Operations		MSOM-Service Operations	MSOM-Service Operations		MSOM-Service Operations
48	L1-101H	Behavioral Operations Mgt.		Behavioral Operations Mgt.	Behavioral Operations Mgt.		Behavioral Operations Mgt.
49	L1-101I	Tutorial-Andrea Lodi		Tutorial-Ciamac Moallemi	Tutorial-Raghu Pasupathy		Tutorial-Uday Shanbhag
50	L1-101J	Energy		Energy	Energy		Energy
51	L1-102D	TSL-Urban Transportation		TSL-Urban Transportation	TSL-Intelligent Transport.Sys. (ITS)		TSL-Intelligent Transport.Sys. (ITS)
52	L1-102E	Revenue Mgt.		TSL- Freight Transport. & Logistics	TSL-Freight Transport. & Logistics		TSL-Freight Transport. & Logistics
53	L1-102F	TSL-Freight Transportation & Logistics		Vehicle Problems	Vehicle Routing Problems		Vehicle Routing Problems
54	L1-103A	TSL-Intelligent Transport. Sys. (ITS)		TSL-Intelligent Transport. Sys. (ITS)	TSL-Intelligent Transport. Sys. (ITS)		TSL-Intelligent Transport. Sys. (ITS)
55	L1-103B	TSL-Intelligent Transportation Systems (ITS)		TSL-Intelligent Transport. Sys. (ITS)	Shift Scheduling		Scheduling
56	L1-103C	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy
57	L1-103D	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy
58	L1-103E	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy
59	L1-103F	ENRE-Environment & Sustainability		ENRE-Environment & Sustainability	ENRE-Environment & Sustainability		Climate Change
60	Mezz-M100A	Data Mining		Data Mining	Data Mining/HAS/AI		Data Analytics
61	Mezz-M100B	Data Mining		Data Mining	Data Mining		Energy, Natural Res. & Env.-Energy
62	Mezz-M100C	QSR		QSR	QSR		QSR
63	Mezz-M100D	QSR		QSR	QSR		QSR
64	Mezz-M100E	Information Systems		Information Systems	Information Systems		Information Systems
65	Mezz-M100F	Social Media Analytics		Social Media Analytics	Social Media Analytics		Social Media Analytics
66	Mezz-M100G	Information Systems		Information Systems	Information Systems		Information Systems
67	Mezz-M100H	Decision Analysis		Decision Analysis	Decision Analysis		DA & Behavioral Operations
68	Mezz-M100I	Decision Analysis		Decision Analysis	Decision Analysis		Decision Analysis
69	Mezz-M100J	Marketing		Marketing	Retail Mgt.		Retail Mgt.
70	Mezz-M101A	Aviation Applications		Aviation Applications	Aviation Applications/TSL		Aviation Applications
71	Mezz-M101B	Aviation Applications		Game Theory	Game Theory		Game Theory
72	Mezz-M101C	Risk Mgt.		Risk Mgt.	Risk Mgt.		Forecasting

Track	Room	WA 8:00-9:30	Plenary 10:00–10:50	WB 11:00-12:30	WC 1:30-3:00	WD 3:30-5:00
1	L2-200A	Optimization in Finance		Optimization in Finance	Optimization in Finance	Optimization in Finance
2	L2-200B	Optimization-Nonlinear Programming		Optimization-Nonlinear Programming	Optimization-Nonlinear Programming	Optimization-Nonlinear Programming
3	L2-200C	Opt.-Global Opt. & . Mixed-Integer Nonlinear Prog		Opt.-Integer Programming	Opt.-Integer Programming	Opt.-Integer Programming
4	L2-200D	Opt.-Integer Programming		Opt.-Integer Programming	Opt.-Integer Programming	Opt.-Integer Programming
5	L2-200E	Opt.-Stochastic Programming		Stochastic Programming	Stochastic Programming	Large Scale Optimization
6	L2-200F	Optimization-Networks	Keynote 2013 UPS George D. Smith Prize Naval Postgraduate School	Optimization-Networks	Optimization-Networks	Optimization-Networks
7	L2-200G	Opt.-Stochastic Programming		Opt.-Stochastic Programming	Opt.-Stochastic Programming	Opt.-Stochastic Programming
8	L2-200H	Computing Society		Computing Society	Computing Society	Computing Society
9	L2-200I	Analytics Section		Analytics Section	Analytics Section	Inventory Mgt.
10	L2-200J	INFORM-ED		INFORM-ED & Analytics	No Session	No Session
11	L2-201A	Social Networks		Demand-Driven Marketing	Pricing, Inventory & Sales Mgt.	Sports & Entertainment
12	L2-201B	Financial Markets	Auditorium 2 Level 1	Portfolio Analysis	Financial Risk	Empirical Finance
13	L2-202A	Disaster & Emergency		Disaster & Emergency	Homeland Security	Intelligent Agents & Systems
14	L2-202B	Supply Chain		Supply Chain	Reverse Supply Chain	Manufacturing & Operations Mgt.
15	L2-203	Service Science		Service Science	No Session	Service Science
16	L2-204	Health Applications		Health Applications	Health Applications	Health Applications
17	L2-205A	Service Science	Keynote Guillermo Gallego Pricing and Product Design in a Data-Driven Economy	Service Science	Service Science	Service Science
18	L2-205B	Queueing Models		Queueing Models	Dynamic Programming	Dynamic Programming
19	L2-205C	Applied Probability		Applied Probability	Matching Markets	Applied Probability
20	L2-205D	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing	Revenue Mgt. & Pricing
21	L2-206	Health Applications		Health Applications	Health Applications	Healthcare
22	L2-207	Healthcare		Healthcare	Healthcare	Healthcare
23	L2-208A	Revenue Mgt. & Pricing	Auditorium 3 Level 1	Revenue Mgt. & Pricing	Revenue Mgt. & Pricing	Revenue Mgt. & Pricing
24	L2-208B	Revenue Mgt. & Pricing		Revenue Mgt. & Pricing	Revenue Mgt. & Pricing	Revenue Mgt. & Pricing
25	L2-208C	No Session		No Session	No Session	No Session
26	L2-208D	No Session		GIS & Spatial Analysis	Facilities Planning	Facilities Planning
27	L2-209A	Inventory Mgt.		Inventory Mgt.	Inventory Mgt.	Inventory Mgt.
28	L2-209B	Applied Probability		Simulation	Simulation & Optimization	No Session
29	L2-210A	BizSimz & Perceptive Analytics		Firm Performance	Technology Mgt.	Effective Teams & Organizations
30	L2-210B	Heuristic Optimization		Heuristic Optimization	Integer Programming Applications	Integer Programming Applications
31	L2-211A	Financial Services		Financial Services	Financial Services	Financial Econometrics & Statistics
32	L2-211B	Technology Mgt.		Technology Mgt.	Technology Mgt.	Technology Mgt.
33	L2-211C	No Session		No Session	No Session	No Session
34	L2-211D	Simulation Society /HAS		Simulation Society	Simulation Society	Simulation Society
35	L2-212A	Network Optimization		Network Optimization	Robust Optimization	Robust Optimization
36	L2-212B	Healthcare		Healthcare	Healthcare	Healthcare
37	L2-213A	Scheduling & Project Mgt.		Project Mgt.	Production Scheduling	Scheduling Manufacturing Operations
38	L2-213B	Supply Chain Mgt.		Supply Chain Mgt.	Supply Chain Mgt.	Supply Chain Mgt.

Track	Room	WA 8:00-9:30	Plenary 10:00–10:50	WB 11:00-12:30	WC 1:30-3:00	WD 3:30-5:00
39	L1-Auditorium 3	No Session		No Session	No Session	No Session
40	L1-Auditorium 2	No Session		No Session	No Session	No Session
41	L1-101A	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.
42	L1-101B	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.	Mfg. & Service Operations Mgt.
43	L1-101C	Mfg. & Service Operations Mgt.		Mfg. & Service Operations Mgt.	Stochastic Optimization	Outsourcing
44	L1-101D	Supply Chain Optimization		Supply Chain Optimization	Supply Chain Optimization	Supply Chain
45	L1-101E	MSOM-Healthcare Operations		MSOM-Healthcare Operations	Supply Chain	Supply Chain & Game Theory
46	L1-101F	Business Operations		Business Operations	Environmental Sustainability & Behavior Adoption	Green Supply Chain Mgt.
47	L1-101G	Operations Mgt.		Operations Mgt.	Operations Mgt.	Procurement & Purchasing
48	L1-101H	Behavioral Operations Mgt.		Behavioral Operations Mgt.	Behavioral Operations Mgt.	Behavioral Operations Mgt.
49	L1-101I	Tutorial-Pekka Korhonen		Tutorial-Tyrrell Rockafellar	Tutorial-John Beasley	Service Systems
50	L1-101J	Remanufacturing		Analytics	Marketing Strategies	Financial Operations Mgt. Under Risk
51	L1-102D	TSL-Intelligent Transport. Systems (ITS)		TSL-Intelligent Transport. Systems (ITS)	TSL-Intelligent Transport. Systems (ITS)	Advances in Logistics
52	L1-102E	TSL-Freight Transportation & Logistics		TSL-Freight Transport. & Logistics	TSL-Freight Transport. & Logistics	TSL-Freight Transport. & Logistics
53	L1-102F	Freight Transportation		Freight Transportation	Maritime Transportation	Multimodal Transportation
54	L1-103A	TSL-Intelligent Transport. Systems (ITS)		TSL-Intelligent Transport. Systems (ITS)	TSL-Intelligent Transport. Systems (ITS)	No Session
55	L1-103B	Scheduling		Scheduling	Scheduling	Strategic Planning & Decision Making
56	L1-103C	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy
57	L1-103D	Energy, Natural Res. & Env.-Energy		Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy	Energy, Natural Res. & Env.-Energy
58	L1-103E	Energy, Natural Res. & Env.-Energy		No Session	Business Applications	No Session
59	L1-103F	Climate Change		Natural Resources Mgt.	Education	Education
60	Mezz-M100A	Data Mining/HAS		Data Mining/HAS/AI	Data Mining	Data Mining
61	Mezz-M100B	Data Mining		OR Interface	Data Mining	Information Systems
62	Mezz-M100C	QSR/ENRE		QSR	QSR	No Session
63	Mezz-M100D	QSR		QSR	QSR	No Session
64	Mezz-M100E	Reliability		Reliability	Reliability	Risk Analysis
65	Mezz-M100F	Transit Operations		Traffic Operations	Operations Mgt.	Increasing Productivity in Mfg.
66	Mezz-M100G	Information Systems		Information Systems	Information Systems	Information Systems
67	Mezz-M100H	Decision Analysis		No Session	Decision Analysis	Decision Analysis
68	Mezz-M100I	Decision Analysis		Decision Analysis	Decision Analysis	Decision Analysis
69	Mezz-M100J	Auctions & Mechanism Design		Auctions & Mechanism Design	Behavioral Operations in Business Mgt.	Behavioral Ops. in Business Mgt.
70	Mezz-M101A	No Session		No Session	No Session	No Session
71	Mezz-M101B	No Session		No Session	No Session	No Session
72	Mezz-M101C	No Session		No Session	No Session	No Session

Auctions
Robert Day
University of Connecticut

Climate Change & O.R.
Mort Webster
Massachusetts Institute of Technology

Erin Baker
University of Massachusetts

Cloud Computing
Ilyas Iyoob
Gravitant, Inc.

Ton Dieker
Georgia Tech

Daniel H. Wagner Prize for Excellence in O.R.
Allen Butler
Daniel H. Wagner Associates, Inc.

Data Envelopment Analysis
Andrew L. Johnson
Texas A & M University

Disease Progression
Kevin Leder
University of Minnesota

Doing Good with Good O.R. Student Competition
Jeremie Gallien
London Business School

Laura McLay
University of Wisconsin Madison

George B. Dantzig Dissertaion Prize
Zeynep Aksin Karaesmen
Koc University

Healthcare Systems/Informatics
Laura McLay
University of Wisconsin Madison

Homeland Security/Defense
Chase Murray
Auburn University

In Memoriam: Saul Gass's Influence in O.R.
Edward Wasil
American University

Arjang Assad
University of Buffalo- SUNY

Michael Fu
University of Maryland

Bruce Golden
University of Maryland

INFORMS Prize – 2013
Stefan Karisch
Jeppesen

INFORMS Career Center
Neil Geismar
Texas A&M University

International Activities Committee
Judy Jin
University of Michigan

KINFORMS (Korea Chapter INFORMS)
Sang Hyung Ahn
Seoul National University

Managing Disruptions in Supply Chain
Ed Pohl
University of Arkansas

Chase Rainwater
University of Arkansas

New Product Development
Jeremy Hutchinson-Krupat
University of Virginia

Karthik Ramachandran
Georgia Institute of Technology

Nicholson Student Paper Prize
Jose Blanchet
Columbia University

Huseyin Topaloglu
Cornell University

Optimization in Finance
David Brown
Duke University

Daniel Kuhn
Imperial College London

Optimization, Spatial Analysis & GIS
Alan Murray
University of Arizona

Richard Church
University of California

O.R. as a Catalyst for Engineering Grand Challenges
Suvrajeet Sen
University of Southern California

Project Management & Scheduling
Nicholas G. Hall
Ohio State University

Marc Posner
Ohio State University

Risk Management
Xuedong Hu
Columbia University

Hongzhong Zhang
Columbia University

Social Media Analysis
Les Servi
MITRE Corporation

Undergraduate Operations Research Prize
Itir Karaesmen
American University

Workforce Engineering & Management
David Nembhard
Pennsylvania State University

Analytics
Michael Gorman
University of Dayton

Michael Katehakis
Rutgers University

Applied Probability
Nilay Tanik Argon
University of North Carolina

Johan van Leeuwaarden
Eindhoven University of Technology

Artificial Intelligence
Kang Zhao
University of Iowa

Aviation Applications
Marcial Lapp
US Airways

Behavioral Operations Management
Andrew Davis
Cornell University

Computing Society
Ted Ralphs
Lehigh University

CPMS, The Practice Section
Ranganath Nuggehalli, CAP
UPS

Data Mining
M.K. Jeong
Rutgers University

Decision Analysis
Victor Jose
Georgetown University

Jagpreet Chhatwal
University of Pittsburgh

Alec Morton
London School of Economics

Energy, Natural Resources & the Environment
Energy
Enzo E. Sauma
Pontificia Universidad Católica de Chile

Environment & Sustainability
Hayri Önal
University of Illinois

Forestry/Mining
Erin Belval
Colorado State University

Alexandra Newman
Colorado School of Mines

e-Business
Marius Florin Niculescu
Georgia Tech

Jui Ramaprasad
McGill University

Jianqing Chen
University of Texas at Dallas

Financial Services
Tim Leung
Columbia University

Health Applications
Pinar Keskinocak
Georgia Tech

Information Systems
Subodha Kumar
Texas A&M University

INFORM-ED
Susan Martonosi
Harvey Mudd College

Junior Faculty Interest Group
Erhun Kundakcioglu
University of Houston

Location Analysis
Larry Snyder
Lehigh University

Stefan Nickel
Karlsruhe Institute of Technology

Manufacturing & Service Operations Management
Sarang Deo
Indian School of Business

Nitin Bakshi
London Business School

Healthcare Operations Management
Wen-Ya Wang
San Jose State University

iFORM
Onur Boyabatli
Singapore Management University

Alex Yang
London Business School

Service Operations
Pnina Feldman
Univ. of California, Berkeley

Supply Chain
Albert Ha
HKUST

Greys Sosic
University of Southern California

Sustainable Operations
Francis de Véricourt
INSEAD

Military Applications
William Fox
Naval Postgraduate School

David Arney
United States Military Academey

Minority Issues
Julie Ivy
North Carolina State University

Multiple Criteria Decision Making
Ralph Steurer
University of Georgia

Optimization
Sanjay Mehrotra
Northwestern University

Computational Optimization & Software
Brian Borchers
New Mexico Tech

Global Optimization & Mixed-Integer Nonlinear Programming
Leo Liberti
LIX, Ecole Polytechnique

Integer Programming
Santanu Dey
Georgia Tech

Linear Programming & Complementarity
Mohammad Oskoorouchi
California State University

Networks
Baski Balasundaram
Oklahoma State University

Nonlinear Programming
Andreas Wächter
Northwestern University

Stochastic Programming
Andrew Schaefer
University of Pittsburgh

Organization Science
Jared Harris
University of Virginia

Public Programs, Service & Needs
Robert Hampshire
Carnegie Mellon University

David Hutton
University of Michigan

Quality, Statistics & Reliability
Haitao Liao
University of Arizona

Railway Applications
Yanfeng Ouyang
University of Illinois

Revenue Management & Pricing
Pelin Pekgun
University of South Carolina

Ronald Menich
Predictix

Service Science
Ming-Hui Huang
National Taiwan University

Simulation
Seong-Hee Kim
Georgia Institute of Technology

SpORts
James J. Cochran
Lousiana Tech University

Joel Oberstone
University of San Franciso

Spreadsheet Productivity Research
Thomas G. Groleau
Carthage College

Technology Management
Sinan Erzurumlu
Babson College

Telecommunications
Abdullah Konak
Pennsylvania State University

Michael R. Bartolacci
Pennsylvania State University

Transportations Science & Logistics
Nicholas E. Lownes
University of Connecticut

Facility Logistics
Ananth Krishnamurthy
University of Wisconsin

Sadan Kulturel-Konak
Pennsylvania State University

Freight Transportation & Logistics
Yanfeng Ouyang
University of Illinois

Tom Van Woensel
Eindhoven University of Technology

Intelligent Transportation Systems (ITS)
Jeff X. Ban
Rensselaer Polytechnic Institute

Urban Transportation
Yueyue Fan
University of California-Davis

Women in OR/MS
Susan Martonosi
Harvey Mudd College

INFORMS MEETINGS

2014

March 30-April 1
INFORMS Conference on Business Analytics & Operations Research
Westin Boston Waterfront
Boston, Massachusetts
Chair: Freeman Marvin, Innovative Decisions Inc.
http://meetings.informs.org/analytics2014/

June 22-24 – **New Conference!**
INFORMS Conference on Big Data
San Jose Convention Center
San Jose, California
Chair: Margery Connor, CAP, Chevron;
Diego Klabjan, CAP, Northwestern University
http://meetings.informs.org/bigdata2014/

November 9-12
INFORMS Annual Meeting 2014 San Francisco
Hilton San Francisco & Parc 55 Wyndham
San Francisco, California
Chair: Candace Yano, Univ. of California-Berkeley
http://meetings2.informs.org/SanFrancisco2014

2015

April 12-14
INFORMS Conference on Business Analytics & Operations Research
Hyatt Huntington Beach
Huntington Beach, California

June 14-17
CORS INFORMS International
Sheraton Montreal
Montreal, Canada
Chair: Louis-Martin Rousseau
Polytechnique Montréal
Louis-martin.rousseau@cirrelt.net

November 1-4
INFORMS Annual Meetings 2015 Philadelphia
Pennsylvania Convention Center & Marriott Philadelphia Downtown
Philadelphia, Pennsylvania
Chair: Tamas Terlaky, Lehigh University
terlaky@lehigh.edu

2016

April 10-12
INFORMS Conference on Business Analytics & Operations Research
Hyatt Regency Grand Cypress
Orlando, Florida

November 13-16
INFORMS Annual Meetings 2016 Nashville
Music City Center & Omni Nashville
Nashville, Tennessee
Chair: Chanaka Edirisinghe, Univ. of Tennessee
chanaka@utk.edu

INFORMS COMMUNITIES

2013

December 8-11
Winter Simulation Conference
JW Marriott
Washington, DC
Chair: Raymond Hill, Air Force Institute of Technology
www.wintersim.org

2014

February 6-9
INFORMS Organization Science Winter Conference
Sheraton Steamboat Springs Resort
Steamboat Springs, Colorado
Chair: Daniel Levinthal, University of Pennsylvania
dlev@wharton.upenn.edu

March 6-8
INFORMS Optimization Society Conference
Rice University
Houston, TX
Chair: Illya Hicks, Rice University
http://www.caam.rice.edu/~ios2014/

June 5-6
INFORMS Revenue Management & Pricing Section Conference
Istanbul, Turkey
Chair: Ilker Birbil, Sabanci University
sibirbil@sabanciuniv.edu

June 9-12
INFORMS Section on Group Decision & Negotiation Conference
Université Sciences Sociales
Toulouse, France
Chair: Melvin Shakun, New York University
http://www.irit.fr/gdn2014/

June 11-14
INFORMS Marketing Society Conference
Emory University
Atlanta, Georgia
Chair: Douglas Bowman
doug_bowman@emory.edu

June 16-18
INFORMS Decision Analysis Society Conference
Georgetown University Hotel & Conference Ctr.
Washington, DC
Co-Chairs: Jason Merrick, VCU;
Robin Dillon-Merrill, Georgetown;
Yael Grushka-Cockayne, University of Virginia
https://www.informs.org/Community/DAS/DAS-Conference

June 19-21
INFORMS MSOM Society Conference
University of Washington
Seattle, Washington
Co-Chairs: Ted Klastorin, Apurva Jain,
University of Washington
http://www.foster.washington.edu/2014msom

October 2-3
INFORMS Southeastern Chapter Annual Meeting
Hilton Myrtle Beach
Myrtle Beach, SC
Chair: Ed Showalter
edshowalter@rmc.edu

December 7-10
Winter Simulation Conference
Savannah International Trade & Convention Ctr. & Westin Savannah
Savannah, Georgia
Chair: Stephen J. Buckley, IBM Research
www.wintersim.org

How to Navigate the Technical Sessions

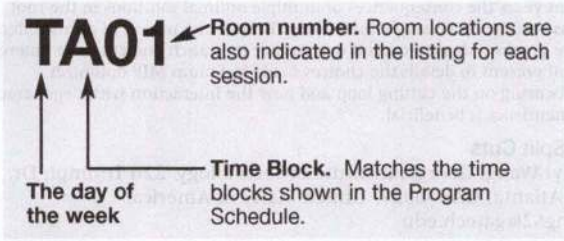
There are four primary resources to help you understand and navigate the Technical Sessions:

- This Technical Session listing, which provides the most detailed information. The listing is presented chronologically by day/time, showing each session and the papers/abstracts/authors within each session.
- The Author and Session indices provide cross-reference assistance (pages 450-484).
- The floor plans on pages 42-44 show you where technical session tracks are located.
- The Master Track Schedule is on pages 46-53.

Quickest Way to Find Your Own Session

Use the Author Index (page 450) — the session code for your presentation will be shown along with the room location. You can also refer to the full session listing for the room location of your session.

The Session Codes



Time Blocks

Sunday - Tuesday

A — 8:00am - 9:30am
B — 11:00am - 12:30pm
C — 1:30pm - 3:00pm
D — 4:30pm - 6:00pm

Wednesday

A — 8:00am - 9:30am
B — 11:00am - 12:30pm
C — 1:30pm - 3:00pm
D — 3:30pm - 5:00pm

Room Locations /Tracks

All tracks and technical sessions will be held in the Convention Center. Room numbers are shown on the Track Schedule and in the technical session listing.

Sunday, 8:00am - 9:30am

■ SA01

Level 2 - Room 200A

Modeling Systemic Risk I

Cluster: Optimization in Finance
Invited Session

Chair: Ciamac Moallemi, Associate Professor, Columbia University, 3022 Broadway Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

Co-Chair: David Brown, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, dbbrown@duke.edu

1 - A Structural Model for Asset Price Contagion and Systemic Risk
Chen Chen, Columbia University, 500 W. 120th St., Mudd 323, New York, NY, 10027, United States of America, chenchen05@gmail.com, Garud Iyengar, Ciamac Moallemi

We develop a structural model for the analysis of systemic risk in financial markets based on asset price contagion. Specifically, we describe a mechanism of contagion where exogenous random shocks to agents in an economy force portfolio rebalancing. This creates an endogenous chain reaction as agents trade in reaction to price changes. Our approach allows us to quantify the effect of attributes such as leverage and portfolio diversity on asset price contagion.

2 - Systemic Risk and Stability in Financial Networks
Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, 418 Uris Hall, New York, NY, 10023, United States of America, alirezat@columbia.edu, Asuman Ozdaglar, Daron Acemoglu

We provide a framework for studying the relationship between the financial network architecture and the likelihood of systemic failures due to contagion of counterparty risk and show that financial contagion exhibits a form of phase transition as interbank connections increase.

3 - How Likely is Contagion in Financial Networks?
Paul Glasserman, Professor, Columbia University, 403 Uris Hall, 3022 Broadway, New York, NY, 10027, United States of America, pg20@columbia.edu, H. Peyton Young

Interconnections among financial institutions create potential channels for contagion and amplification of shocks. We bound the network impact on defaults and expected losses under a range of shock distributions. Our analysis assumes only minimal information about network topology, which is important because financial networks are opaque. We find that network effects are small without a high degree of reliance on interbank funding. We illustrate the results with data on the European bank system.

4 - Exploring the Sources of Default Clustering
Gustavo Schwenkler, Boston University, 595 Commonwealth Ave., Boston, MA, 02215, United States of America, gschwenk@stanford.edu, Kay Giesecke, Shahriar Azizpour

We develop goodness-of-fit testing and prediction for event timing models in which the arrival intensity is influenced by past events and incompletely observed covariates. Applying these tools to US defaults between 1970 and 2012, we find that there is significant default contagion after controlling for macro-economic covariates and an unobserved frailty that prior studies have identified as predictors of US defaults. Both frailty and contagion are significant sources of default clustering.

■ SA02

Level 2 - Room 200B

Optimization for Acquisition Decision Support and Trade Analysis

Sponsor: Optimization/Computational Optimization and Software
Sponsored Session

Chair: Matthew Hoffman, Sandia National Laboratories, PO Box 5800, MS 1188, Albuquerque, NM, United States of America, mjhoffm@sandia.gov

1 - Evolution of an Optimization Software Project in a Production Environment: Lessons Learned
Matthew Hoffman, Sandia National Laboratories, PO Box 5800, MS 1188, Albuquerque, NM, United States of America, mjhoffm@sandia.gov

We apply a mixed-integer programming tool to portfolio-level defense acquisition problems, which selects modernization plans to maximize future fleet performance under budget, production, and programmatic constraints. As the project has evolved in a constantly changing high-impact analysis environment we have gained insight into process, architecture, and capabilities that help us adapt quickly to changes in data or key assumptions while maintaining high levels of confidence in analysis output.

2 - Implementing the CPAT Mixed-integer Fleet Modernization Optimization Model Formulation

Darryl Melander, Sandia National Laboratories, PO Box 5800-1188, Albuquerque, NM, 87185, United States of America, djmelan@sandia.gov

Military fleet modernization schedules and investment strategies must assure optimal fleet performance while respecting cost, schedule, production, and programmatic constraints. We will present formulation insights into the Capability Portfolio Analysis Tool (CPAT) mixed-integer optimization model used to provide decision support for military fleet modernization planning, focusing on the translation of customer business motivations into implementation choices.

3 - A Study of Various Model Formulations and Settings for a Real-world Large-scale Acquisition Problem

Frank Muldoon, Sandia National Laboratories, 1515 Eubank, Albuquerque, NM, United States of America, fmmuldo@sandia.gov

Given the need to model and solve large defense acquisition problems quickly and efficiently, it is important to create specific formulations with particular settings that achieve these goals. We investigate the effects of various model formulations and optimization parameter settings for one such Army acquisition problem. We describe various cases in which different formulations and settings decreased solution times and integrality gaps in addition to instances that had the opposite effect.

4 - Holistic Fleet Modernization: Integrating Vehicle and Portfolio Design Optimization

Stephen Henry, Systems Analyst, Sandia National Laboratories, PO Box 5800-1188, Albuquerque, NM, 87185, United States of America, smhenry@sandia.gov

Fleet portfolio management must consider complicated sets of tradeoffs, both in individual vehicle design and in the incorporation of vehicles into the fleet. Unfortunately, individual vehicles are currently developed without optimal fleet assimilation analysis. Similarly, fleet optimization currently does not methodically consider future vehicle configuration uncertainty. We will discuss a framework for unifying these decision processes and discuss the challenges and opportunities that arise.

■ SA03

Level 2 - Room 200C

Stochastic Optimization

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Ted Ralphs, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, ted@lehigh.edu

1 - Stochastic Network Design with Rerouting

Ruibin Bai, Associate Professor, University of Nottingham Ningbo, 199 Taikang East Road, Ningbo, China, ruibin.bai@nottingham.ac.uk, Stein Wallace

Service network design under uncertainty is fundamentally crucial for all freight transportation companies. We proposed a new robust freight service network design model with vehicle rerouting options. The proposed model explicitly introduces a set of integer variables for vehicle rerouting in the stochastic program. Although computationally expensive, the resultant model provides more options and flexibility for planners to deal with uncertainties more effectively.

2 - A Two-stage Stochastic Optimization Model for Container Relocation Problem

Setareh Borjian, Massachusetts Institute of Technology, 60 Wadsworth Street, Cambridge, Ma, 02142, United States of America, sborjian@mit.edu, Vahideh Manshadi, Patrick Jaillet, Cynthia Barnhart

We present an integer programming formulation for the container relocation problem (CRP) under dynamic setting, i.e., continual stacking and discharging of the items. Further, we develop a two-stage stochastic optimization model for CRP under uncertainty, which minimizes the expected number of relocations and total delay in the discharging process.

3 - Optimal Design of Mixed AC-DC Distribution Systems for Commercial Buildings

Steffen Rebennack, Colorado School of Mines: Division of Economics and Business, 816 15th Street, Golden, CO, 80501, United States of America, srebenna@mines.edu, Stephen Frank

We present a mathematical program and global optimization algorithm which determine maximally energy efficient designs for mixed AC-DC building electrical distribution systems. The research approach precisely quantifies building electrical energy efficiency at a systems level. The results of two case studies validate the optimization algorithm and demonstrate that well designed mixed AC-DC building systems can achieve higher efficiency than either AC or DC distribution used alone.

■ SA04

Level 2 - Room 200D

Recent Progress in Mixed Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Amar Narisetty, Senior Operations Research Specialist, SAS Institute, 100 SAS Campus Drive, Cary, NC, 27513, United States of America, Amar.Narisetty@sas.com

1 - New Approaches to Mixed Integer Programming Heuristics

Philipp Christophel, Operations Research Specialist, SAS Institute Inc., 100 SAS Campus Dr, Cary, NC, 27513, United States of America, philipp.christophel@sas.com, Menal Güzelsoy, Imre Pòlik

Mixed integer programming (MIP) solver software heavily relies on a potentially large number of primal heuristics to identify or improve primal solutions to the problem at hand. In this talk we discuss priviously unexplored structural properties of MIP problems and how to exploit them to get better primal heuristics.

2 - Exploiting Degeneracy in Sulum MIP Optimizer

Bo Jensen, CEO, Sulum Optimization, Kaasvaenget 45, Middelfart, 5500, Denmark, bo.jensen@sulumoptimization.com

In the recent years the consequences of multiple optimal solutions in the root node LP has become increasingly interesting. Besides the notion of erratic effects on the solve process, ideas to exploit degeneracy in branch and cut have emerged. This talk will present in details the choices made in Sulum MIP optimizer, especially focusing on the cutting loop and how the interaction with degeneracy exploiting heuristics is beneficial.

3 - Wide Split Cuts

Qianyi Wang, Georgia Institute of Technology, 226 Triumph Dr. NW, Atlanta, GA, 30327, United States of America, qwang62@gatech.edu

The traditional split cut is obtained using a disjunctive argument corresponding to a lattice-free convex set. We introduce a new class of cuts obtained using a similar argument where we replace the lattice-free set with a larger set which may not be lattice-free. To verify the validly of these cuts, we solve a lower dimensional sub-MIP. We will present theoretical and empirical results about this class of cutting planes.

4 - On the Polyhedral Structure of Two-Level Lot-Sizing Problems Arising in Vendor Managed Inventory

Ayse Arslan, PhD Student, University of Florida, Department of Industrial and Systems, Engineering 303 Weil Hall, Gainesville, FL, 32608, United States of America, arslan.aysenur@gmail.com, Jean-Philippe Richard, Yongpei Guan

We study a family of vendor-managed inventory models. We first present a polynomial-time dynamic programming algorithm and the corresponding extended formulation. In addition, we perform a polyhedral study of the corresponding set. We obtain several families of facet-dening inequalities which provide the convex hull description for two periods. We present computational results that show the strength of these inequalities in a branch-and-cut algorithm.

■ SA05

Level 2 - Room 200E

Network Optimization Under Uncertainty

Sponsor: Optimization/Networks

Sponsored Session

Chair: Qingwei Li, Eastman Chemical Company, 200 S. Wilcox Dr., Kingsport, United States of America, qli@eastman.com

1 - A Stochastic Team Orienteering Problem with Budget and Time Constraints

Belleh Fontem, PhD Candidate, University of Alabama, 300 Alston Hall, Tuscaloosa, AL, 35487, United States of America, bafontem@crimson.ua.edu, Burcu Keskin, Sharif Melouk

We consider the problem of detecting and reaching uncertain node locations on a network subject to budget and time constraints. We introduce a new very tight formulation for the resulting team orienteering problem and propose a robust optimization framework to find solutions that are immune to uncertainty affecting the time constraints. We solve test instances and glean general computational insights.

2 - Location of Quick Charging Facilities for Electric Vehicles

Yan Li, The Hong Kong University of Science and Technology, Tower B702C, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, yliaj@ust.hk, Ho-Yin Mak

To overcome limited driving ranges of electric vehicles, quick charging facilities are required. We propose a model to measure suitability of locating quick chargers at candidate locations as a function of geographical location and drivers' heterogeneous preferences. We show the relationship between the facility selection problem and a production planning problem with random cost.

3 - Multi-stage Scenario Tree Generation for Reliable Production Planning of Integrated Sites

Bruno A. Calfa, Graduate Student, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, bacalfa@cmu.edu, Ignacio E. Grossmann, Anshul Agarwal, John M. Wassick, Scott J. Bury, Joe J. Czyzyk

This work considers a network of highly interconnected chemical plants that are geographically distributed and that are subjected to uncertainties in demands and plant reliability. We describe NLP and LP approaches to quantify the uncertainty in the historical data to systematically generate scenario trees for multistage stochastic programming. The approaches can be used when the uncertainty consists of independently observed data or stochastic processes.

4 - Facility Design under Disruptions

Qingwei Li, Eastman Chemical Company, 200 S. Wilcox Dr., Kingsport, United States of America, qli@eastman.com

Two models were developed for facility design under disruptions.

■ SA06

Level 2 - Room 200F

Extensions of Second-Order Cone Programming

Sponsor: Optimization/Linear Programming and Complementarity

Sponsored Session

Chair: Hande Benson, Associate Professor, Drexel University, Department of Decision Sciences, 3141 Chestnut St., Philadelphia, PA, 19104, United States of America, hvb22@drexel.edu

1 - Mathematical Optimization Techniques for Multi-vehicle Motion Planning

Pramod Abichandani, Drexel University, 3141 Chestnut Street, Philadelphia, United States of America, pramod@drexel.edu

Multi-Vehicle Motion Planning (MVMP) problems require the optimization of suitable performance measures under an array of complex and challenging constraints involving kinematics, dynamics, collision avoidance, and communication connectivity. We provide a step-by-step demonstration of how to formulate and experimentally validate a MINLP with second-order cone constraints that represents an MVMP problem. Finally, we discuss the advantages, technical challenges, and limitations of this framework.

2- Multiperiod Portfolio Optimization with Cone Constraints and Discrete Decisions

Umit Saglam, Ph.D. Candidate, LeBow College of Business, Drexel University, Philadelphia, PA, 19104, United States of America, us26@drexel.edu, Hande Benson

We consider a portfolio optimization problem where the investor's objective is to choose a trading strategy that maximizes expected return penalized by transaction costs. We include portfolio diversification constraints in our single and multiperiod models. The overall problem is a mixed-integer second-order cone programming problem, which we solve with the Matlab-based solver MILANO. This talk will focus on the solution and warm-start of the second-order cone programming subproblems.

■ SA07

Level 2 - Room 200G

Data Driven Methods in Stochastic Programming

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Guzin Bayraksan, The Ohio State University, Integrated Systems Engineering, Columbus, OH, United States of America, bayraksan.1@osu.edu

Co-Chair: Yongpei Guan, University of Florida, 303 Weil Hall, Gainesville, United States of America, guan@ise.ufl.edu

1 - Properties of Phi-Divergence Constrained Ambiguous Stochastic Programs

David Love, University of Arizona, Applied Mathematics, 617 N. Santa Rita Ave., Tucson, AZ, 85721, United States of America, dlove@math.arizona.edu, Guzin Bayraksan

In this talk, we investigate the properties of the phi-divergence based ambiguous stochastic programs recently proposed by Ben-Tal et. al. We examine the value of collecting additional data and the convergence to the associated non-ambiguous stochastic program. A decomposition-based solution algorithm to solve the resulting model is given. We apply the method to a water distribution problem in Tucson, Arizona.

2 - Improved Assessment of Solution Quality Applied to Sequential Sampling in Stochastic Programming

Rebecca Stockbridge, Wayne State University, 1150 Faculty/Administration, 656 W. Kirby, Detroit, MI, 48202, United States of America, rebecca.stockbridge@gmail.com, Guzin Bayraksan

We present a computational study of bias and variance reduction methods applied to optimality gap estimators. Techniques discussed include Latin Hypercube sampling, antithetic variates, and a probability metrics approach to bias reduction. We discuss the results of applying these methods to sequential sampling algorithms.

3 - Risk Averse Data Driven

Chaoyue Zhao, University of Florida, United States of America, cherryzhao09@ufl.edu, Yongpei Guan

In this talk, we study the two-stage stochastic optimization with incomplete information of probability distributions of random parameters.

■ SA08

Level 2 - Room 200H

Optimal Learning for Expensive, Complex Functions

Sponsor: Computing Society

Sponsored Session

Chair: Warren Powell, Director, PENSA Laboratory, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, powell@princeton.edu

1 - Bayesian Multi-information Source Optimization with Expensive Function Evaluations

Jialei Wang, Cornell University, Rhodes Hall, Ithaca, NY, 14850, United States of America, jw865@cornell.edu

We propose a knowledge-gradient policy for noisy global optimization with multiple information sources. The policy uses value of information calculations and Bayesian statistics to decide, at each point in time, both at which point in the design space to evaluate, and which information source to use in this evaluation. We present an application to materials science, in which one information source is a computationally expensive simulator, and the other is a physical experiment.

2 - Bayesian Optimal Learning with Generalized Linear Model

Si Chen, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, sichen@princeton.edu, Warren Powell

The knowledge-gradient policy is an optimal learning policy that maximizes the expected value of information in each time period. We extend the this policy to a broader class of prior distributions by introducing the generalized linear model(GLM). GLM unifies various statistical models, such as linear regression, logistic regression and Poisson regression. With proper sampling methods and numerical integration, we demonstrate that the knowledge-gradient algorithm for GLM is efficient.

3 - Bayesian Active Learning for Finding Maximally-valued Exemplars
Peter Frazier, Assistant Professor, Cornell University, School of ORIE, Rhodes Hall, Ithaca, NY, United States of America, pf98@cornell.edu, Jialei Wang

We consider a Bayesian optimal search problem, related to active learning and arising in an application to materials science. In active learning, we have training data with unknown binary labels. Obtaining labels is expensive, and we wish to obtain a small number of labels, so that the statistical classifier built from them is good. We consider a variant in which each datapoint has an associated known value, and our goal is to find a datapoint with a positive label and large value.

■ SA09

Level 2 - Room 200I

Workforce Analytics

Sponsor: Analytics Section

Sponsored Session

Chair: Shrikant Jarugumilli, Sr. Operations Research Specialist, BNSF Railway, 2400 Western Center Blvd, Ft. Worth, TX, 76131, United States of America, Shrikant.Jarugumilli@bnsf.com

1 - Scheduling a 24/7 Distinctly Qualified Workforce
Mike Swindler, Director Transportation Process, BNSF Railway, 2400 Western Center Boulevard, Fort Worth, TX, 76131, United States of America, michael.swindler@bnsf.com, Tony Craig, Shrikant Jarugumilli

The BNSF Train Dispatching office is a 24/7/365 operation that has 105 dispatching districts covered by approximately 550 distinctly qualified train dispatchers. This discussion will concentrate on difficulties the BNSF encountered when developing a scheduling application. BNSF's scheduling algorithm will be discussed at a high level, as will our vacancy allocation and workforce planning models.

2 - Handling Unplanned Absences in Rail Dispatcher Scheduling
Tony Craig, Postdoctoral Associate, Massachusetts Institute of Technology, 77 Massachusetts Ave., E40-211, Cambridge, MA, 02139, United States of America, tcraig@mit.edu

In rail dispatch each absent employee must be covered by a qualified extra board dispatcher or through the use of overtime. Using data on historical absences, we employ a Poisson regression to identify factors influencing the number of absences. We then analyze the qualifications of current dispatchers and develop a simulation model to predict how changes in the workforce size and qualifications impact the cost of handling unplanned absences.

3 - Optimization Models for Planning and Scheduling a 24/7 Workforce
Shrikant Jarugumilli, Sr. Operations Research Specialist, BNSF Railway, 2400 Western Center Blvd, Ft. Worth, TX, 76131, United States of America, Shrikant.Jarugumilli@bnsf.com, Siva Veluchamy, Kruthika Nagaraj, Juan Morales, Mike Swindler

The BNSF Train Dispatching office is a 24/7/365 operation that has 105 dispatching districts covered by approximately 550 distinctly qualified train dispatchers. This discussion will concentrate on the optimization models for workforce planning and scheduling in these offices.

4 - Workforce Planning Models in Semiconductor Manufacturing
Anirudha Kulkarni, Rochester Institute of Technology, Industrial and Systems Engineering, 81 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, apk2932@rit.edu, Shrikant Jarugumilli, Naiping Keng, Scott Grasman

Workforce planning in semiconductor manufacturing facilities can be tricky considering the complex shift patterns and the business rules. In this presentation we discuss the various observations we encountered while implementing such models in real industry settings.

■ SA10

Level 2 - Room 200J

Fostering the OR/MS Pipeline

Sponsor: INFORM-ED

Sponsored Session

Chair: Sadan Kulturel-Konak, Professor of Management Information System, Pennsylvania State University, Tulpehocken Rd., PO Box 7009, Reading, PA, 19610, United States of America, sadan@psu.edu

1 - Mentoring High School, Undergraduate & Graduate Students - Lessons Learned by an Assistant Professor
Jun Zhuang, Assistant Professor, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, United States of America, jzhuang@buffalo.edu

Mentoring students could be both an extremely frustrating and an extremely rewarding process, especially for junior faculty without extensive experiences. In this talk, we will share some lessons learned by an assistant professor from mentoring a large group of high school, undergraduate and graduate students on research in the past five years. We will discuss the strategies of recruiting, mentoring, maintaining, and graduating students, including those from underrepresented groups.

2 - Sparking the OR Flame in High Schools
Daria Terekhov, Mechanical and Industrial Engineering, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, dterekho@mie.utoronto.ca, Christian Muise, Timothy Chan, Maliheh Aramon Bajestani, Tony T. Tran, T. K. Feng, J. Christopher Beck

The Operations Research Challenge (TORCH) is an annual one-day University of Toronto contest whose main goal is to interest high-school students in OR. Teams of 3 or 4 students solve a variety of OR questions, ranging from fun ones such as finding the best strategy in the game of Starcraft to serious ones, such as devising a treatment plan for lung cancer. This talk will describe the setup of the contest, its growth since 2011, example problems, and student feedback.

3 - Developing Project Management Skills through Senior Design
Anita Vila-Parrish, Teaching Assistant Professor, North Carolina State University, Campus Box 7906, Raleigh, No, 27695, United States of America, arvila@ncsu.edu

This talk will be focused on a project management framework used at North Carolina State University in the Edward P. Fitts Department of Industrial & Systems Engineering's senior design course. We will discuss how project management and lean six methodologies are used to provide a structure to the course, evaluate student progress, and develop a sought after skill set for graduates who go on to OR/ISE careers.

4 - Assessing Professional Skills through Model of Domain Learning
Sadan Kulturel-Konak, Professor of Management Information System, Pennsylvania State University, Tulpehocken Rd., PO Box 7009, Reading, PA, 19610, United States of America, sadan@psu.edu, Abdullah Konak

In this study, a novel assessment framework based on a pedagogical theory, the Model of Domain Learning (MDL) is proposed to assess student development in various professional skills across STEM disciplines. The project aims to facilitate the integration of professional skills assessment into an overall program assessment plan. We have created and administered a pilot test measuring team-work communication skills of college students and findings of this test will be presented.

■ SA11

Level 2 - Room 201A

Distributed Approaches

Sponsor: Telecommunications

Sponsored Session

Chair: Abdullah Konak, Professor of Information Sciences and Technology, Penn State Berks, Tulpehocken Road, PO Box 7009, Reading, PA, 19610, United States of America, konak@psu.edu

1 - A Distributed Algorithm for Energy-efficient Data Center Operations
Young Myoung Ko, Assistant Professor, Pohang University of Science and Technology, 77, Cheongam-ro, Nam-gu, Pohang, 790-784, Korea, Republic of, youngko@postech.ac.kr

Rapid spread of mobile devices such as smart phones and tablets brings about increasing needs for large-scale data centers that process and store the data produced by mobile devices. However, several studies reveal that current data center operations are undesirably energy inefficient because all servers are

running at their full capacity around the clock regardless of demand changes over time. We propose a novel distributed algorithm that effectively reduces energy consumption of data centers.

2 - Distributed Parallel Process Particle Swarm Optimization on Fixed Charge Network Flow Problems

Corey Clark, DeVry University, 4800 Regent Blvd, Irving, TX, 75063, United States of America, cclark@gametheorylabs.com, Charles Nicholson

We develop a parallel process particle swarm optimization (PSO) on an HTML5 based dynamically distributed system and assess its performance as applied to the multicommodity fixed charge (MCFC) network flow problem. The MCFC problem is motivated by a real-world cash management problem faced by large national banks and is NP-hard. We compare the performance of a serial and distributed parallel process PSO implementation and empirically evaluate the optimality gap for multiple instances.

3 - Practically Efficient Separations for Edge-failure Resilient Network Design

Richard Chen, Quantitative Modeling and Analysis, Sandia National Laboratories, Livermore, CA, United States of America, rlchen@sandia.gov, Cynthia Phillips

We consider the problem of designing a multicommodity network subject to edge-failure resiliency criterion. We present MILP formulations, valid inequalities and compact separation problems that avoid exhaustive searches over the exponential number of failure scenarios. Empirical studies on previously unsolved instances of SNDlib demonstrate the effectiveness of our approach.

4 - Improving Network Connectivity in Ad-Hoc Networks using Intelligence Agents

Abdullah Konak, Professor of Information Sciences and Technology, Penn State Berks, Tulpehocken Road, PO Box 7009, Reading, PA, 19610, United States of America, konak@psu.edu

This paper presents a decentralized approach to maintain the connectivity of a MANET using autonomous, intelligent agents that collaborate. The presentation introduces several network metrics, including ones form the social network analysis, to maintain the connectivity of mobile nodes. Computational results are presented to demonstrate the effect of various metrics on the global network connectivity.

■ SA12

Level 2 - Room 201B

Entrepreneurship and Social Capital

Sponsor: Organization Science

Sponsored Session

Chair: Mabel Abraham, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, United States of America, mlba@mit.edu

1 - You Get What You Give, or Do You? A Comparison of Resource Sharing among Entrepreneurs

Mabel Abraham, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, United States of America, mlba@mit.edu

It is established that network benefits are greater for men than for women. Extant research has attributed this gender difference in benefits to network structure, arguing that men and women are embedded in different networks. This focus provides a limited explanation as the benefits of social ties are contingent on an actor's ability to mobilize resources. I address this gap using a unique research setting to compare the returns to social capital for men and women embedded in the same networks.

2 - Gender and Internal Venturing Choices

Aleksandra Kacperczyk, Assistant Professor, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, United States of America, olenka@mit.edu

Using unique data on mutual funds and hedge funds founded between 1979 and 2005, I assess gender differences in the pursuit of new ventures. Although women transition to entrepreneurship at lower rates than men, they are more likely to pursue alternative venturing routes available inside an established organization. The results further indicate that higher rates of female intrapreneurship are unlikely to arise because of gender differences in risk-taking behaviors, differential sorting, and differential labor supply. Instead, I find evidence consistent with the notion that women tend to pursue internal venturing options because such tasks match their skills and lifestyle choices.

3 - Stigma, Sympathy, and the Double Edge of Strong Ties: Social Capital Activation in Job Searches

Sanaz Mobasseri, University of California, Berkeley, Haas School of Business, Berkeley, CA, United States of America, sanaz_mobasseri@haas.berkeley.edu, Sameer Srivastava, Andras Tilcsik

We examine a fundamental puzzle concerning people's decisions to activate their social ties to help a job seeker who is in their social network but bears a potentially stigmatizing mark, such as physical deformity or history of socially disapproved behavior. Such marks might limit the extent of help provided to a job seeker because of concerns about courtesy stigma; yet, they might also facilitate help by triggering sympathy. Contrary to intuitive predictions, we argue that 'subject to scope conditions' sympathy will dominate stigmatization. Further, we illuminate the double edge of strong ties in this process: while these ties increase motivation to help, they simultaneously intensify the risk of courtesy stigma. Thus, when the job seeker is perceived to be responsible for acquiring a potentially stigmatizing mark, strong ties provide no more socially observable help – in the form of social capital activation – than do weak ties. Using a mark that facilitated causal identification (an accident-related scar), an experiment with a diverse population of 483 employed adults validated our hypotheses. We draw important implications for research on stigma, social capital, and labor markets.

4 - The Networks Don't Lie: Variations in Social Relationships as a Basis for Differentiating Self-employment, Business Ownership, and Various Types of Entrepreneurship

Jason Greenberg, New York University, Stern School of Business, New York, NY, United States of America, jgreenbe@stern.nyu.edu

In this paper I provide a theoretical basis for distinguishing self-employment, business ownership, and various notions of entrepreneurship by describing the social relational characteristics of the individuals or teams engaged in them. The approach I take here builds on work by sociologist Harrison White concerning identity claims and networks, to wit: social actors can make identity claims that deviate significantly from their "true" identities. What they cannot fake, however, are their objective social ties. Thus, as the title of this paper suggests, "the networks don't lie." Observing an actor's actual social connections reveals her identity.

■ SA13

Level 2 - Room 202A

Learning Issues in Technology and Innovation Management

Cluster: New Product Development

Invited Session

Chair: Aravind Chandrasekaran, The Ohio State University, 2100 Neil Avenue, Columbus, United States of America, chandrasekaran_24@fisher.osu.edu

1 - Risk, Process Maturity, and Project Performance: An Empirical Analysis of Federal IT Projects

Anant Mishra, Professor, George Mason University, Fairfax, VA, United States of America, amishra6@gmu.edu, James Murray, Sidhartha Das

Federal IT initiatives are organized in the form of large IT projects that require the coordinated execution of multiple, interdependent tasks, each of which may span diverse knowledge bases. Managing risks in such projects is a matter of serious concern for the government. Using longitudinal data collected from federal IT projects within a global high technology firm, this study identifies project risks and examines the role of process maturity (CMMI) in managing their performance impact.

2 - Fit or Disrupt? A Co-Evolutionary View on Landscape Change and Innovation Strategies

Fabian Sting, Erasmus University, Rotterdam, Netherlands, fsting@rsm.nl, Murat Tarakci

Adaptation scholars have studied firms which perform search to increase their fit with their environments; whereas other researchers have documented firms which disrupt their technology landscape. To explain why firms strive to fit or to disrupt their landscape, we move beyond the current understanding of exogenous landscape changes by incorporating co-evolutionary interactions. Using simulations, we explain the heterogeneity in organizations' innovation strategies with performance objectives.

3 - Adopting Administrative Innovations a Race or Resource?
Kevin Linderman, University of Minnesota, 3-150 Carlson School of Management, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, linde037@umn.edu, Hung-Chung Su, Suvrat Dhanorkar

Companies face pressure to adopt newer technologies and conform to the most up-to-date standards. The "Red Queen Effect" argues that firms achieve superior performance through outpacing their rivals in adopting latest technologies. On the other hand, it could be argued that firms could potentially extract greater value from developing existing standards through the "Organizational Learning Effect". Using longitudinal data of ISO 9001 and ISO 14001 we attempt to reconcile these two perspectives.

■ SA14

Level 2 - Room 202B

Modeling Risk in Supply Chains

Cluster: Managing Disruptions in Supply Chain

Invited Session

Chair: Kash Barker, Assistant Professor, University of Oklahoma, 202 West Boyd, Room 124, Norman, OK, 73019, United States of America, kashbarker@ou.edu

1 - A Bayesian Network Approach to a Supply Chain Risk Management Framework
Myles Garvey, Ph.D Student, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, myles.garvey@rutgers.edu, Steven Carnovale, Sengun Yeniyurt

This research advances a framework for supply chain risk management and derives structural network measures of risk, leveraging a Bayesian Belief Network (BBN). The composition of the supply network allows for the development of a BBN in order to formally and analytically capture the risk profile of a supply network. Further, we extend current understanding of supply chain risk management by incorporating supply network structure and causality of risk for a holistic perspective.

2 - Importance Measures for Inland Waterway Network Resilience
Hiba Baroud, PhD Student, University of Oklahoma, 202 West Boyd St., Rm. 124, Norman, OK, 73019, United States of America, hbaroud@ou.edu, Kash Barker, Jose Emmanuel Ramirez-Marquez, Claudio Rocco

Inland waterways are critical elements in supply chains, allowing for the flow of commodities across industries and geographic locations. This work presents stochastic resilience-based importance measures that highlight the critical waterway links that contribute to waterway network resilience and uses them to motivate the order in which links should be recovered. A data-driven case study illustrates these metrics to describe commodity flows along the various links of the US Mississippi River.

3 - Supply Chain Risk Assessment Applying System Dynamics Approach, Case Study: Apparel Industry
Marzieh Mehrjoo, University of Windsor, 335 Detroit St., Apt. 6, Windsor, ON, n9c2p4, Canada, mehrjoo@uwindsor.ca, Zbigniew J Pasek

A remarkable increase in the demand and supply uncertainty have increased the necessity of assessing and managing the risk in the supply chain. The purpose of this study is to investigate the impact of different categories of risk on the performance of an apparel supply chain. A system dynamics approach was used to study the behavior and relationships within the supply chain. The proposed model provides a tool to generate multiple business scenarios for effective decision making.

■ SA15

Level 2 - Room 203

Meet the Editor of Service Science

Sponsor: Service Science

Sponsored Session

Chair: Gregory Heim, Associate Professor, Texas A&M University, INFO Department Mays Business School, 320 Wehner Building 4217 TAMU, College Station, TX, 77843-4217, United States of America, GHeim@mays.tamu.edu

1 - Service Science Editor's Report: Manuscript Statistics, Readership, and Strategic Directions
Paul Maglio, Professor, University of California, Merced, 5200 N. Lake Road, Merced, CA, 95343, United States of America, pmaglio@ucmerced.edu

Service Science Editor-In-Chief Dr. Paul Maglio will review the state and direction of the newest INFORMS journal, Service Science. This session will summarize 2012 reviewing statistics for submitted manuscripts, existing readership, financial condition, and other data about the journal. The session will introduce the 2013-2014 Editorial Review Board (ERB). Dr. Maglio will present his vision for the strategic direction of Service Science, followed by a question-and-answer opportunity.

■ SA16

Level 2 - Room 204

Data-driven Models in Healthcare Applications

Sponsor: Health Applications

Sponsored Session

Chair: Stefanos Zenios, Stanford University, Graduate School of Business, 518 Memorial Way, Stanford, CA 94305-5015 stefzen@leland.stanford.edu

Co-Chair: Joel Goh, Stanford University, Faculty Building East E105, 655 Knight Way, Stanford, CA, 94305, United States of America, joelgoh@stanford.edu

1 - Improving Hospital Queueing with Future Information
Kuang Xu, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, kuangxu@mit.edu, Carri Chan

With an increase in availability of patient data, new predictive models are being developed. This begs the questions: How can forecasts and predictions of the future be used to improve the efficiency and effectiveness of healthcare delivery? We examine a class of queueing models and admissions control problems in emergency departments. We show, both analytically and via simulations, that system efficiency can be substantially improved by the access to (limited) future information.

2 - What Drives the Geographical Differences in Deceased Donor Organ Procurement in the United States?
Mazhar Arikan, Assistant Professor, University of Kansas, School of Business, Lawrence, KS, United States of America, mazhar@ku.edu, Rodney Parker, John J. Friedewald, Baris Ata

The deceased-donor kidney allocation system suffers from severe shortages of available organs while there is significant variation in the procurement rates across different geographies in the US. The empirical analysis reveals that the intent of procurement increases with organ quality, the median waiting time for a transplant, and the competition among transplant centers. A counterfactual study shows that broader sharing of lower quality organs leads to an increase in the procurement rates.

3 - Patients without Patience: An Econometric Model of Waiting in the Intensive Care Unit
Elisa Long, UCLA Anderson School of Management, Los Angeles, CA, 90095, United States of America, elisa.long@anderson.ucla.edu, Kusum Mathews

High utilization levels in the hospital intensive care unit (ICU) and other hospital departments may impact patients' length of stay and thus contribute to long wait times for a bed. Using 12 months of data for Yale-New Haven Hospital (a 51-bed ICU), we develop an econometric model to estimate the impact of crowdedness on length of stay and bed transfer time, and the subsequent impact of waiting on mortality and readmission rates.

4 - The Relationship between Workplace Practices and Mortality and Health Costs in the United States

Joel Goh, Stanford University, Faculty Building East E105, 655 Knight Way, Stanford, CA, 94305, United States of America, joelgoh@stanford.edu, Jeffrey Pfeffer, Stefanos Zenios

Empirical evidence has linked workplace practices to health outcomes, but the aggregate contribution of these factors to mortality and health spending in the U.S. is not known. We use a model to estimate the excess mortality and health spending associated with workplace exposures. Our model was designed to overcome inherent data limitations. We find that 120,000 deaths and 5-8ä of healthcare costs per year are associated with how U.S. companies manage their work force.

■ SA17

Level 2 - Room 205A

Gaining Business Insights from Big Data Analytics on Federated Data Sources

Sponsor: Service Science

Sponsored Session

Chair: Neil Boyette, Research, IBM Research Almaden, 650 Harry Rd., San Jose, CA, 95120, United States of America, nboyette@us.ibm.com

1 - Unlocking the Value of Improved Service Level in Outsourcing Services for Optimal Capacity Decision

Sechan Oh, IBM Research, 650 Harry Road, San Jose, CA, United States of America, seoh@us.ibm.com, Ankit Shah, Anca Chandra, Sumeet Kaur, Diana Negoescu, Gerhard Satzger

In IT and business process outsourcing services, service firms often need to acquire additional capacity for new service contracts before the contracts are signed because of the long leadtime for capacity acquisition. In order to make the optimal capacity investment decision, firms need to quantify the benefit of improved service level, which does not have a direct impact on revenue. In this talk, we present a federated data analysis approach to connect financial data and operational data.

2 - Analytics for Three-way and Dynamic Network Data with Application to Financial Market Surveillance

Shawn Mankad, University of Michigan, 1085 South University Ave., 439 West Hall, Ann Arbor, MI, 48109, United States of America, smankad@umich.edu, George Michailidis

We introduce new tools to address the challenges of analyzing the increasingly vast and complex data encountered in Finance, Economics and Marketing. Specifically, we consider analyzing collections of data matrices that are typically organized from transaction-level data, and introduce a model for regularized matrix factorization that captures how structure evolves through time. The tools are used to summarize how lending dynamics in the interbank market changed during the sub-prime crisis.

3 - Real-time Traffic Anomaly Detection for IT Incident Management

Feng Li, Dr., IBM Research - China, Diamond Building, Beijing, China, lfeng@cn.ibm.com, Emily Liu, Lijun Mei, Jery Li, Juhnyoung Lee, Qi Cheng Li

Real-time traffic anomaly detection plays a key role in IT Incident Management as heavy workload and traffic on servers and networks is one of primary causes IT incident in enterprise computing environment. It can provide alert messages to users for preventive actions. In this study, a real time traffic anomaly detection solution is presented. It firstly determines patterns for traffic metrics; then describes traffic metrics by using an ARIMA model; and finally identifies any traffic anomaly.

■ SA18

Level 2 - Room 205B

Logistics/Capacity Management

Sponsor: Service Science

Sponsored Session

Chair: Abigail L Horn, Massachusetts Institute of Technology, Cambridge, MA, United States of America, abbyhorn@mit.edu

1 - A Service-based Comparison for Stochastic Clearing Systems

Sila Cetinkaya, Texas A&M University, Austin, TX, United States of America, sila@tamu.edu, Bo Wei, Daren B.H. Cline

Considering a Poisson demand process, we develop a unified method for calculating average order delay (AOD) under different clearing policies using the view of martingales. Next, we introduce some refined properties of truncated Poisson random variables and offer an analytical comparison of AOD expressions for a fixed clearing frequency, e.g., expected service cycle length. The problem has direct applications in freight consolidation among other stochastic clearing systems.

2 - Planning for Equipment Rental and the Traveling Equipment Problem

Hakan Yildiz, Michigan State University, 632 Bogue St. N341, North Business College Complex, East Lansing, MI, 48824, United States of America, yildiz@bus.msu.edu

We study a business model that provides services using its equipment, which are stored in a network of warehouses. We consider this problem in the context of seating and staging services in the entertainment industry, where the planning process is quite complicated as it involves managing thousands of pieces of modular equipment among warehouses and events, such as concerts and sports games. We investigate improvement opportunities in terms of inventory & transportation management and pricing.

3 - Modeling Supply Chain System Structure to Trace Sources of Food Contamination

Abigail L Horn, Massachusetts Institute of Technology, Cambridge, MA, United States of America, abbyhorn@mit.edu

This research aims to facilitate faster, more accurate tracing of sources of contaminated food during large-scale outbreak investigations. We analytically model stylized versions of the problem of traceback on food supply chain network structures to derive exact theoretical results that lead to new, general insights. We then develop implementable algorithms that identify the highest probability source of contamination in the most efficient manner given realistic limitations on data availability.

■ SA19

Level 2 - Room 205C

Call Centers I

Sponsor: Applied Probability

Sponsored Session

Chair: Amy Ward, Associate Professor, University of Southern California, Marshall School of Business, Bridge Hall 401H, Los Angeles, CA, 90089, United States of America, amyward@marshall.usc.edu

1 - Accuracy of the Last-to-enter Service Delay Announcement

Rouba Ibrahim, University College London, Gower Street, London, United Kingdom, rouba.ibrahim@ucl.ac.uk, Mor Armony, Achal Bassamboo

We investigate ways of making delay announcements in large service systems, such as call centers. We consider announcing the delay of the last customer to enter service (LES) to delayed customers, upon arrival. We explicitly model announcement-dependent customer behavior. We show that, for appropriate initial conditions, the LES announcement is asymptotically accurate in both the quality-and-efficiency-driven (QED) and the efficiency-driven (ED) many-server heavy-traffic regimes.

2 - Impact of Delay Announcements in Call Centers: an Empirical Approach

Seyed Emadi, Assistant Professor, University of North Carolina at Chapel Hill, Kenan-Flagler Business School, 300 Kenan Dr., Chapel Hill, NC, 27599, United States of America, s-emadi@kellogg.northwestern.edu, Zeynep Aksin Karaesmen, Baris Ata, Che-Lin Su

We undertake an empirical study of the impact of delay announcements on callers' abandonment behavior and the performance of a call center with two priority classes. We develop a methodological framework to find the steady-state equilibrium by combining the estimation of callers reward and cost parameters, the model of callers' abandonment behavior and the queuing analysis that incorporates this behavior.

3 - A Logarithmic Safety Staffing Rule for Contact Centers with Call Blending

Ohad Perry, Assistant Professor, Northwestern University, Evanston, IL, United States of America, ohad.perry@northwestern.edu, Guodong Pang

We study a large-scale contact center that handles inbound and outbound calls. Inbound calls arrive as an exogenous stream of customers with impatience, while outbound calls are modeled as an infinite queue of jobs, waiting to be processed. The goal is to serve inbound calls subject to service level constraints while keeping the outbound throughput rate at a desired level. We show that a logarithmic safety staffing is sufficient to meet these objectives.

4 - Staffing and Routing to Incentivize Servers in Many-server Systems
Ragavendran Gopalakrishnan, University of Colorado-Boulder, Boulder, CO, United States of America, raga@colorado.edu, Sherwin Doroudi, Adam Wierman, Amy Ward

Traditionally, research focusing on the design of scheduling and staffing policies for service systems has modeled servers as having fixed (possibly heterogeneous) service rates. However, service systems are often staffed by people. Then, the rate a server chooses to work is impacted by the system's scheduling and staffing policies. We consider the impact of "strategic servers" on system performance in many-server systems. (There is a companion talk in the M&SOM cluster.)

■ SA20

Level 2 - Room 205D

Asymptotic Methods in Large-Scale Service Systems

Sponsor: Applied Probability

Sponsored Session

Chair: Guodong Pang, Assistant Professor, Pennsylvania State University, Industrial Engineering, University Park, PA, 16802, United States of America, gup3@psu.edu

1 - Gaussian Approximation for a Fork-join Network with Non-exchangeable Synchronization
Guodong Pang, Assistant Professor, Pennsylvania State University, Industrial Engineering, University Park, PA, 16802, United States of America, gup3@psu.edu, Hongyuan Lu

We study a fork-join network with K service stations of many servers and non-exchangeable synchronization. Each customer's service is forked into K parallel tasks, each of which is processed in the corresponding station and waits in a separate buffer to be synchronized after service completion. For general arrivals and service times of all tasks (possibly correlated), in a quality-driven many-server regime, we derive a Gaussian approximation for the service and synchronization dynamics.

2 - Asymptotic Optimality of Constant-order Policies for Lost Sales Models with Large Lead Times
David A. Goldberg, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, dgoldberg9@isye.gatech.edu, Mark Squillante, Mayank Sharma, Yingdong Lu, Dmitriy Katz

Lost sales inventory models with large lead times are difficult to optimize due to the curse of dimensionality. In this talk we show that when lead times are large, a simple constant-order policy, first studied by Reiman, is nearly optimal. The main insight is that when the lead time is large, so much randomness is injected into the system between when an order is placed and when that order is received, that no algorithm can beat the constant-order policy.

3 - Refined Approximations for Many-server Queues in the ED+QED Regime, with Applications to Delay Announcements While Waiting
Junfei Huang, Chinese University of Hong Kong, Hong Kong, Hong Kong - PRC, junfeih@gmail.com, Avishai Mandelbaum, Hanqin Zhang, Jiheng Zhang

Motivated by delay announcement in call centers, we study many-server queues in the ED+QED regime. We propose a refined approximation, allowing the patience time distribution to be rather general. This helps one accommodate customer behavior in response to delay announcements. Our refined approximation not only accurately captures the impact of announcements on system performance, but it also provides insights on call center management - specifically via the optimal solution to the problem of (jointly) staffing servers and making announcements to customers.

4 - Laguerre Polynomial Expansions for Multiserver Queues
Jamol Pender, Princeton University, Sherrerd Hall Princeton University, Princeton, NJ, 08544, United States of America, jpender@Princeton.EDU

With many non-stationary queueing models, we must settle for only estimating their moment behavior since obtaining other information is very difficult to obtain or intractable. To estimate the moments, we expand the queueing process via Laguerre polynomials and use a truncated expansion to derive approximate expectations terms. We show that three or four terms of the Laguerre polynomial sequence is enough to estimate cumulant moments such as the mean, variance, skewness, and kurtosis.

■ SA21

Level 2 - Room 206

Resource Allocation in Dynamic Healthcare Settings

Sponsor: Health Applications

Sponsored Session

Chair: Jackie Griffin, Assistant Professor, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA, 02115, United States of America, ja.griffin@neu.edu

1 - Coordinating Transitions from Hospital to Skilled Nursing Facilities
Jonathan Helm, Indiana University, 1309 E. 10th St., Bloomington, IN, United States of America, helmj@indiana.edu, Sean Yu

Skilled nursing facilities (SNF) are a major bottleneck to discharging patients from hospitals in a timely manner. These facilities typically have two main sources of patients: hospital and community. High utilization at SNFs forces a choice of which patients to admit and which to delay. We develop an event-based dynamic programming approach to optimal admission control at the SNF that seeks to balance the needs of hospital, SNF, and community.

2 - Tactical Planning in Health Care with Approximate Dynamic Programming
Martijn Mes, Assistant Professor, University of Twente, Dep. Industrial Engineering and Business, PO Box 217, Enschede, 7500AE, Netherlands, m.r.k.mes@utwente.nl, Peter Hulshof

We consider a method to develop tactical resource and elective patient admission plans, with the objective to achieve equitable access and treatment duration for patient groups, to serve the strategically agreed target number of patients. We present an Approximate Dynamic Programming approach to determine the number of patients to be treated in each stage of each care process, taking into account multiple resources and multiple patient groups with various care processes.

3 - Patient-bed Assignment Policies in Hospital Systems
Jackie Griffin, Assistant Professor, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA, 02115, United States of America, ja.griffin@neu.edu, Pinar Keskinocak

To alleviate overcrowding in hospitals, hospitals may implement policies that address the management of patient arrivals through the redirection of patients to other hospitals. We model the hospital unit as a Markov chain and develop type-specific threshold policies for patient assignment while simultaneously addressing three distinct objectives.

4 - Models and Methods for Robust and Dynamic Decision Making in Mass Participation Event Planning
Mehmet Basdere, MS, Northwestern University, Evanston, IL, United States of America, MehmetBasdere2016@u.northwestern.edu, Sanjay Mehrotra, Colleen Ross, Jennifer Chang, George Chiampas, Karen Smilowitz

In this talk, we present an overview of an on-going collaboration between the medical team of the Chicago Marathon and faculty from Industrial Engineering and Management Sciences. The goal is to optimize decision-making for mass participation events using operations research methodologies. As such, the research will lead to advances in medical preparedness and response for mass participation events and new developments in robust and dynamic logistics and resource allocation models.

■ SA22

Level 2 - Room 207

Data Driven Policy Improvements

Cluster: Healthcare Systems/Informatics

Invited Session

Chair: Maria Mayorga, Clemson University, Raleigh, NC, United States of America, mayorga@clemson.edu

1 - A Colorectal Cancer Screening Model Incorporating Patient Choice
Maria Mayorga, Clemson University, Raleigh, NC, United States of America, mayorga@clemson.edu, Kristen Hassmiler-Lich

Despite its demonstrated effectiveness, colorectal cancer (CRC) screening is sub-optimal. Furthermore, most studies comparing different screening recommendations assume that all patients behave the same. We use a validated US-level agent-based model (ABM) that had incorporates patient preferences for alternate screening compliance as well as for screening modalities, thus accounting for patient heterogeneity. Cost effectiveness analyses are conducted using North Carolina claims data.

2 - Balancing Block Size, OR Requirements, and Risk
Kevin Taaffe, IE Graduate Coordinator and IIE Faculty Advisor, Clemson University, 130-A Freeman Hall, Clemson, SC, 29634, United States of America, taaffe@clemson.edu, Rebecca Weiss, Lawrence Fredendall

Hospitals have unique preferences in how surgical block times are set for each specialty group or practice. We study the impact of flexibility in risk ratios by group, shared block or open posting time across multiple groups, as well as how an organization may characterize a high quality block schedule. Results indicate that inefficiencies introduced by standard block schedules result in additional ORs being open as well as unused staff labor hours. Data was provided by a major local hospital.

3 - An Agent-based System Model to Study Health Policy
Shinyi Wu, Assistant Professor, University of Southern California, 3650 McClintock Ave., OHE 310R, Los Angeles, CA, 90089, United States of America, shinyiwu@usc.edu, Pai Liu

We developed an Agent-based model to study the US healthcare delivery and policy. Our model includes interacting agents representing the key stakeholders in the health system. The agents would respond to the policy by changing their behaviors. Using this model to study Accountable Care Organizations (ACOs), the results show non-linear patterns of provider behaviors in responding to gradients of payment model in accordant with providers' priorities, suggesting payers to expand its strategies.

■ SA23

Level 2 - Room 208A

Online Stochastic Optimization and Online Advertising

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Vahab Mirrokni, Senior Staff Research Scientist, Google Research, 111 8th Ave., New York, United States of America, mirrokni@theory.csail.mit.edu

1 - Bicriteria Online Matching: Maximizing Weight and Cardinality
Morteza Zadimoghaddam, PhD Student, Massachusetts Institute of Technology, 32 Vasser Street, Csail Room 32G678, Cambridge, MA, 02139, United States of America, zadimoghaddam@gmail.com, Nitish Korula, Vahab Mirrokni

Inspired by online ad allocation, many results have been developed for online matching problems. Most of the previous work deals with a single objective, but, in practice, we need to optimize multiple objectives. We consider a set of fixed nodes (ads) with capacity constraints, and a set of online items arriving one by one. The problem is to assign each item to a neighbor online, while respecting the capacity constraints; and maximizing both the total weight of the matching and the cardinality.

2 - Approximate Dynamic Mechanism Design with Budget-Constrained Agents
Santiago Balseiro, Assistant Professor, Duke University, Durham, NC, United States of America, srb2155@columbia.edu, Omar Besbes, Gabriel Weintraub

In online advertising, ad slots are typically allocated using a second-price auction or a suitable modification of it. In this work, we explore, using a mechanism design approach, whether other auction formats could improve the auctioneer's profit in the presence of budgets and other side constraints. In principle, this dynamic mechanism design problem is intractable. However, leveraging a Fluid Mean-Field Equilibrium approach we are able to obtain promising preliminary results for this problem.

3 - Bayesian Optimal Mechanism Design via Multi to Single Agent Reduction
Saeed Alaei, Postdoctoral Researcher, Cornell University, Ithaca, NY, United States of America, saeed.a@gmail.com, Hu Fu, Nima Haghpanah, Jason D. Hartline, Azarakhsh Malekian

We reduce the Bayesian optimal multi agent mechanism design problem to single agent problems in environments where the space of jointly feasible allocations is captured by a polymatroid. Our reduction works by optimizing over the space of feasible interim allocation rules (a.k.a reduced form auctions). We characterize the space of feasible interim allocation rules as a polymatroid, generalizing the result of Border(1991). We present an application of our result to display advertising.

4 - Mechanism Design Problems in Advertising Exchanges
Vahab Mirrokni, Senior Staff Research Scientist, Google Research NYC, 542 W 112th Street, New York, NY, 10025, United States of America, mirrokni@google.com

In this talk, I will discuss various mechanism design and stochastic optimization optimization problems in the context of advertising exchanges. In particular, I will present results about optimal revenue-sharing double auctions, optimal auctions in the presence of intermediaries, and revenue-maximizing auctions in the presence of budget constraints.

■ SA24

Level 2 - Room 208B

Analytics and Segmentation for Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Pelin Pekgun, Assistant Professor, University of South Carolina, Moore School of Business, Columbia, SC, 29205, United States of America, pelin.pekgun@moore.sc.edu

1 - Optimal Switching Time of Entertainment Shows
Srini Krishnamoorthy, Assistant Professor, Ivey School of Business, Western University, London, ON, N6B3R6, Canada, skrishnamoorthy@ivey.uwo.ca, Kyle Maclean

We model a decision problem faced by the management of a theatre that exhibits entertainment shows like movies or plays. The management has to decide every week whether they should continue with the current show or replace it with a new one. We formulate the problem as a stochastic dynamic program and outline the optimal policy that maximizes expected revenue.

2 - An Airline Revenue Management Project
Anton Kleywegt, Associate Professor, ISyE - Georgia Tech, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, anton@isye.gatech.edu, Jim Dai, Weijun Ding, Yi Zhang, Xinchang Wang, Haiyue Yu

We discuss a revenue management project with a large airline for a very busy and competitive market. We discuss how we estimated models of customer arrivals, competitor decisions, customer choices, booking to ticketing conversion, cancellations, no-shows, and go-shows. These were used as input in an optimization model to optimize fareclass opening decisions throughout the booking horizon.

3 - Customer Segmentation for Customized Pricing
Tudor Bodea, InterContinental Hotels Group, Three Ravinia Drive, Atlanta, GA, 30346, United States of America, tudor_bodea@hotmail.com, Mark Ferguson

We show that the segmentation techniques routinely used for customized pricing often violate the requirements of the normative segmentation theory. To overcome this problem, we introduce a model-based recursive partitioning algorithm that provides a sound theoretical framework for segmenting markets based on demand functions representative of customers' response to a firm's offering. Our work supports the use of the ideal bases for normative segmentation in customized pricing applications.

4 - Choice Modeling vs. Price Optimization for Revenue Management
Pelin Pekgun, Assistant Professor, University of South Carolina, Moore School of Business, Columbia, SC, 29205, United States of America, pelin.pekgun@moore.sc.edu, Mark Ferguson

Traditional revenue management methods, based on inventory controls that assume independence between the customer classes, are no longer effective in an environment where prices and product offerings are highly transparent. Two approaches that have been proposed to address this include discrete choice modeling approaches and price sensitive demand models with price optimization. In this talk, we present the recent work in this area, and discuss the pros and cons of each approach.

■ SA25

Level 2 - Room 208C

Auction Theory and Practice

Cluster: Auctions

Invited Session

Chair: Eric Sodomka, Brown University, 115 Waterman Street, Providence, RI, 02912, United States of America, sodomka@cs.brown.edu

1 - The Simple Economics of Approximately Optimal Auctions

Nima Haghpanah, PhD Student, Northwestern University, Evanston, IL, United States of America, nima.haghpanah@gmail.com, Saeed Alaei, Hu Fu, Jason D. Hartline

We consider mechanism design in environments where the agents have multi-dimensional and non-linear preferences. In these environments maximizing marginal revenue may not be optimal, and furthermore, there is sometimes no direct way to implementing the marginal revenue maximization mechanism. We characterize the settings for which marginal revenue maximization is optimal and we show that marginal revenue maximization is approximately optimal.

2 - Information Asymmetries in Common-value Auctions with Discrete Signals

Vasilis Syrgkanis, PhD Student, Cornell University, Upson Hall, Dept. of Comp.Sci., Ithaca, NY, 14853, United States of America, vasilis@cs.cornell.edu, David Kempe, Eva Tardos

We study a common-value hybrid auction among two bidders, where the highest bidder wins and pays his bid with positive probability k, and the second-highest bid with the remaining. Bidders receive asymmetric and affiliated discrete signals. We explicitly characterize the (unique) equilibrium and show that: revenue is non-increasing in k; the second-price auction equilibrium selected by taking k to 0 entails free-riding; the Linkage Principle fails even in first-price auction with binary signals.

3 - Display Advertising with an Ad Exchange and Prediction Uncertainty

Eric Sodomka, Brown University, 115 Waterman Street, Providence, RI, 02912, United States of America, sodomka@cs.brown.edu

Publishers in display advertising face difficult challenges in both prediction and optimization. A publisher must predict what users will arrive to its site and how bidders on an ad exchange will respond to different reserve prices. The publisher must then decide, as each impression arrives, how to set reserve prices and which ads to show to maximize its long-term expected profit. We propose and evaluate algorithms for acting in this domain with uncertainty in predictions.

■ SA26

Level 2 - Room 208D

Location Logistics

Sponsor: Location Analysis

Sponsored Session

Chair: Kayse Maass, University of Michigan, 503 Greenwich Dr., Apt. M, Howell, MI, 48843, United States of America, leekayse@umich.edu

1 - Flexible Hub Location Model for Air Transportation Networks

Yong Liang, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, United States of America, yongliang@berkeley.edu, Ye Xu, Z. Max Shen

Air transportation networks suffer a lot from disruptions caused by severe weather, natural disasters, power outage, etc. We propose a flexible hub-and-spoke structure, and formulate the problem as a mixed-integer program that minimizes various of costs terms. Benders decomposition algorithm is applied to solve this problem. We present numerical studies to show the performance of the network with flexible hub assignment, and some other insights.

2 - Reliable Infrastructure Location Design under Interdependent Disruptions

Xiaopeng Li, Mississippi State University, Department of Civil and Environmental En, PO Box 9546, 235L Walker Hall, 501 Hardy, Mississippi State, MS, 39759, United States of America, xli@cee.msstate.edu, Fan Peng, Yanfeng Ouyang

This paper proposes a facility location model under interdependent facility disruption risks. We propose a supporting station structure that decomposes complicated interdependent disruptions at service facilities into much simpler i.i.d. disruptions at supporting stations. We consolidate the reliable location design problem under an exponential number of disruption scenarios into a compact polynomial-size integer programming model. This model can be efficiently solved by commercial solvers.

3 - Stochastic Patient-centered Long-term Care Network Design

Leyla Ozsen, San Francisco State University, 1600 Holloway Ave., San Francisco, CA, United States of America, lozsen@sfsu.edu, Paul Intrevado

A multistage stochastic network facility model for long-term care is presented as a mixed-integer program, capturing patient quality-of-life. Stochastic patient flows and demands are examined. An illustrative example based on empirical data is presented and results discussed.

4 - A New Approach for Integrating Inventory into Capacitated Facility Location Modeling

Kayse Maass, University of Michigan, 503 Greenwich Dr., Apt. M, Howell, MI, 48843, United States of America, leekayse@umich.edu, Siqian Shen, Mark Daskin

While current capacitated fixed charge location problems use hard and fast capacities, in reality, facility managers have many operational tools to extend capacity or to allow the facility to accept demands in excess of the capacity constraint for short periods of time. The model we present begins to capture these operational extensions and is motivated by the explosion in the availability of massive amounts of transactional data. Computational results will be provided.

■ SA27

Level 2 - Room 209A

MAS Session I

Sponsor: Military Applications

Sponsored Session

Chair: William Fox, Naval Postgraduate School, 589 Dyer Road, Room 214, Monterey, CA, 93943, United States of America, wpfox@nps.edu

1 - Selecting a Portfolio of Network Attack Response Plans

Christian Klaus, Naval Postgraduate School, 1411 Cunningham Road, Monterey, United States of America, cklaus@nps.edu, Nedialko Dimitrov

Consider a tri-level defender-attacker-defender problem: (1) A defender picks m paths from a source to a sink in a network. (2) An attacker removes n arcs from the network. (3) The defender moves from the source to the sink, using the shortest non-attacked path from his initial portfolio. We call this the m-n-shortest paths problem. Even the simplest such problem, the 2-1-SP, is NP-complete. We create a computationally tractable method of addressing the problem and some of its generalizations.

2 - Lookahead or Lookback: A Hybrid Architecture in Approximate Dynamic Programming

Haitao Li, Assistant Professor, University of Missouri-St. Louis, 229 Express Scripts Hall, One University Blvd, St. Louis, MO, 63121, United States of America, lihait@umsl.edu, Keith Womer

The complementary strengths of lookup table and rollout policy in approximate dynamic programming have motivated the idea of combining the two. On one hand, the lookup table directly associates the cost-to-go function with a state-action pair, which offers an accurate and reliable function approximation. On the other hand, for a high-dimensional MDP, it is often not possible to visit every state. For those state-action pairs that have not been visited/evaluated by the lookup table, the rollout approach can be employed to evaluate them. This hybrid approximation architecture has been implemented for stochastic project scheduling problems and shows promising results.

3 - Made-to-Order Production Scheduling using Bayesian Updating

Keith Womer, Professor, University of Missouri, College of Business Administration, One University Blvd, St. Louis, MO, 63121, United States of America, womerk@umsl.edu, J Camm, C. Osterman, R. Radhakrishnan, Haitao Li

Production planning for made-to-order (MTO) manufacturing optimizes the production rate in each period before a promised delivery date. As products in MTO are often unique and customized, the associated learning curve slope and other production parameters cannot be accurately estimated before production starts. In this paper, a dynamic and adaptive solution approach is developed to estimate the effects of learning and production rate in conjunction with optimization. This approach offers a closed-loop solution through dynamic programming. Monthly production data are used to update the joint probability distributions of production parameters via Bayesian methods. Our approach is illustrated using historical data from the U.S. Army's Black Hawk Helicopter Program. Managerial insights are obtained and discussed.

■ SA28

Level 2 - Room 209B

Humanitarian Logistics

Contributed Session

Chair: Miguel Jaller, Rensselaer Polytechnic Institute, JEC 4037, Troy, United States of America, jallem@rpi.edu

1 - Models for a Fair Relief Distribution Network

Ana Maria Anaya-Arenas, PhD Student, Université Laval - CIRRELT, 2325, Rue de la Terrasse, Pavillion Palasis-Prince, Local 2643, Quebec, Qc, G1V 0A6, Canada, AnaMaria.AnayaArenas@cirrelt.ca, Angel Ruiz, Jacques Renaud

The emergency logistics field is a new and particular challenge for logistics'managers. In these networks, the satisfaction of the affected people's demand is much more important than the cost minimization. Moreover, crisis managers are looking for a network that ensures an equitable distribution of resources over affected people. We propose a new mathematical formulation that reflects this interest, and its effectiveness is supported by the numerical results on random generated instances.

2 - Casualty Response Planning during Catastrophic Radiological Incidents

Aakil Caunhye, Student, Nanyang Technological University, 112, #08-34, Ho Ching Road, Singapore, 610112, Singapore, aakil.cau@gmail.com, Mingzhe Li, Xiaofeng Nie

We build a model that locates alternative care facilities and considers triage and the movement of self-evacuees in devising a casualty allocation plan for catastrophic radiological incidents. Using the model, we analyze issues related to the creation of surge capacity, the fair and equitable treatment of casualties, and the incorporation of self-evacuees in planning. We apply the model to a possible radiological dispersal device scenario in a densely populated region of Los Angeles.

3 - Strategic Decision-making about Fundraising: Comparison of Competitive and Joint Fundraising Modes

Fuminori Toyasaki, Associate Professor, York University, 4700 Keele Street, Toronto, ON, M3J1P3, Canada, toyasaki@yorku.ca, Tina Wakolbinger

We provide insights into the current controversy regarding the merits and demerits of joint fundraising. Factors that affect individual players' decisions about participation in a joint fundraising organization are identified. Specifically, we highlights that three representative allocation rules currently applied in the humanitarian context only lead to beneficial allocations for a narrow range of parameters. We also propose a new allocation rule that overcomes these shortcomings.

4 - Responsiveness in Humanitarian Logistics: The Role of Information Processing

Elliot Rabinovich, Arizona State University, W. P. Carey School of Business, Supply Chain Management Dept, Tempe, United States of America, Elliot.Rabinovich@asu.edu, Eunae Yoo

In humanitarian logistics, there has been a growing trend of adopting information processing systems to enhance the responsiveness of aid delivery. By using such systems, organizations can take advantage of information sharing and its benefits, including improved coordination and reduced uncertainty. We seek to explore this phenomenon using organizational information processing theory and a simulation based on actual disaster situations experienced by relief organizations in the field.

5 - Dynamic Control of Material Convergence After Disasters

Miguel Jaller, Rensselaer Polytechnic Institute, JEC 4037, Troy, United States of America, jallem@rpi.edu, Jose Holguin-Veras

The paper develops a mathematical model for the dynamic control of material convergence, which is the flow of supplies and equipment sent by individuals, organizations and governments to the impacted area. Control is essential because the convergent flows are very large and heterogeneous, with items ranging from high-priority to completely useless donations. The objective is to maximize the benefits from these flows, by optimally allocating resources for their control, handling, and processing.

■ SA29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - AnyLogic North America - Multi-Method Modeling in AnyLogic

Scott Hebert, Consulting Engineer, AnyLogic North America, 3333 Warrenville Road, Suite 200, Lisle, IL, 60532, United States of America, shebert@anylogic.com

Come see the AnyLogic Company give a live demonstration where you will see the only solution that lets you combine agent-based, system dynamics and discrete-event modeling techniques within a single model with one platform. Don't miss your chance to learn more and see how AnyLogic can help your business.

2 - McGraw-Hill Education - Introducing Practice Operations: Single-Player Game for the Introductory Operations Management Course

Heather A. Kazakoff, McGraw-Hill Education, 2 Penn Plaza, New York, NY, 10121, United States of America, heather_kazakoff@mcgraw-hill.com, Thomas Hayward

McGraw-Hill Practice Operations provide a lively, interactive experience that focuses on student learning through trial and error within holistic game play, where students see how the elements of operations and production come together. Highlights the inherently interdisciplinary nature of business by demonstrating that the various functional areas of the company, human resources, manufacturing, accounting, and sales must work together in order to meet company goals. Provides reporting features that make it easy for instructors to assess player performance and decision-making.

■ SA30

Level 2 - Room 210B

Workforce Optimization in Health Care

Cluster: Workforce Engineering and Management

Invited Session

Chair: Su Xie, Stanford University, Graduate School of Business Knight Way, Stanford, 94305, United States of America, xiesu@stanford.edu

1 - Forecasting and Dynamic Adjustments of Staffing Level in Operating Rooms

Su Xie, Stanford University, Graduate School of Business, Knight Way, Stanford, 94305, United States of America, xiesu@stanford.edu

In this paper, we consider strategy that allows managers to review and adjust staffing levels on a weekly basis as information accumulates. We use dynamic programming to formulate the problem of setting the optimal staffing strategy that minimizes total staffing costs. Numerical analysis suggests that the ability to adjust staffing levels dynamically in response to information about the types of cases can lead to a reduction of up to 20% in total expected operating room labor costs.

2 - Appointment Scheduling with Follow-up Visits

Yichuan Ding, University of British Columbia, 4735 W. 4th Ave., Vancouver, BC, V6T1C3, Canada, Daniel.Ding@sauder.ubc.ca

Properly modeling outpatient arrivals helps physicians make better decisions regarding panel sizing and appointment scheduling. This paper models the patient follow-up phenomenon and investigates its effect on appointment scheduling. By formulating the problem as a Markov Decision Processes, we concluded that the optimal scheduling policy is of a control-limit type, and the optimal daily booking-limit decreases as days move towards the future.

3 - Capacity Management and Patient Routine Decisions of an Intensive Care Unit with Step-down Units

Lijian Lu, Columbia Business School, Uris Hall 4Q, 3022 Broadway, New York, NY, 10027, United States of America, ll2755@columbia.edu, Carri Chan, Linda Green

We consider the optimization of patient routine from an intensive care unit (ICU) when there are step-down units. We provide the characterization of the optimal routine policy and construct some easily implemented and efficient heuristics. We also propose a theoretic framework to optimize the capacities of variant inpatients units. The empirical data is used to calibrate the theoretical results.

■ SA31

Level 2 - Room 211A

Stochastic Control and Filtering in Finance

Sponsor: Financial Services

Sponsored Session

Chair: Agostino Capponi, Johns Hopkins University, Whitehead Hall 3400, North Charles Street, Baltimore, United States of America, agcappo@gmail.com

1 - Risk Indifference Pricing in Stochastic Volatility Models

Stephan Sturm, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA, 01609, United States of America, ssturm@wpi.edu

An appealing approach for pricing derivatives in incomplete markets is to understand prices as reservation prices. We assume that the buyer is indifferent between buying the derivative for the price in question and not buying the derivative at all. We propose an approach that is based on a risk-indifference pricing, that is we calculate a reservation price describing the buyer's indifference in terms of residual risk after hedging the position.

2 - A Linear Programming Approach to Some Impulse Control Problems

Chao Zhu, Associate Professor, University of Wisconsin, Milwaukee, WI, United States of America, zhu@uwm.edu, Richard Stockbridge, Kurt Helmes

We consider stochastic impulse control problems and their applications in finance and inventory control. Both long term average and discounted cost criteria are examined. The analysis imbed the impulse control problems in infinite-dimensional linear programs over spaces of occupation measures and then analyze auxiliary problems having fewer constraints. In this manner upper bounds are determined for the optimal value; which in turn lead to the value functions and optimal control policies.

3 - Robustness of the N-CUSUM Stopping Rule

Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave., 928, New York, NY, 10027, United States of America, hz2244@columbia.edu, Neofytos Rodosthenous, Olympia Hadjiliadis

We study the quickest change-point detection in a N-dimensional correlated Brownian system. It is assumed that the drifts after the changes are time invariant, but that their sizes and onset times may differ. The objective is the optimal detection of the first time at which any component in the system receives a drift. Under an extended Lorden's performance index, we prove that the N-CUSUM stopping rule is asymptotically optimal as the mean time to the first false alarm increases without bound.

4 - Optimal Investment in Credit Derivatives Portfolio under Contagion Risk

Agostino Capponi, Johns Hopkins University, Baltimore, MD, United States of America, acappon1@jhu.edu, Lijun Bo

We consider the optimal portfolio problem of a power investor who wishes to allocate her wealth between several credit default swaps (CDSs), a stock, and a money market account. We model contagion risk using a Markovian model with interacting default intensities. We establish a lattice dependence structure between the HJB equations associated with the default states of the portfolio. We assess the impact of default contagion on size and directionality of the investor strategy.

■ SA32

Level 2 - Room 211B

Product Development and Deployment in Entrepreneurial Settings

Sponsor: Technology Management

Sponsored Session

Chair: Sinan Erzurumlu, Babson College, 231 Forest St., Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Optimal Learning and Development Strategy for Entrepreneurial Product Launch

Onesun Yoo, Assistant Professor, University College London, Gower Street, London, WC1E 6BT, United Kingdom, o.yoo@ucl.ac.uk, Tingliang Huang

An early stage entrepreneurial firm with a new product concept must maximize the chance of successful product launch. To avoid developing an unwanted product, practitioners suggest a lean approach to development, i.e., a firm should iteratively launch an unfinished product to learn what the consumers want and to alter the final product goal whenever necessary. We formalize this approach via the Bayesian learning framework, and investigate the optimal development strategy.

2 - Ownership Allocation between Entrepreneurs and Venture Capitalists

Meyyappan Narayanan, Assistant Professor of Entrepreneurship, Fairleigh Dickinson University, 285 Madison Avenue, Madison, NJ, 07940, United States of America, meyyappan.narayanan@gmail.com

We model ownership allocation in venture capital investment using agency theory and find that, for the entrepreneur to receive maximal economic rent, the venture capitalist (VC) should be allocated ownership equaling the VC's output elasticity—namely, the importance of the VC's service to the success of the venture—and the entrepreneur should be allocated all the rest, and vice versa.

3 - Business, R&D, and Open Innovation: An Empirical Study of How Managers Differ in Strategy and Focus

John Angelis, Rochester Institute of Technology, Saunders College of Business, Rochester, NY, jangelis@saunders.rit.edu, Joseph Miller, John Ettlie

We analyze a study of open innovation (OI) in firms by Forrester Research for Innocentive. Overall, business managers have a broader, more optimistic perception of OI, particularly in relation to market. R&D managers are more sensitive to information flow barriers and emphasize different tactics in applying OI.

4 - Entrepreneurial Technology Commercialization

Sinan Erzurumlu, Babson College, 231 Forest St., Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu, Karthik Ramachandran, Yusen Xia

Startup firms in many technology intensive industries license innovations to potential competitors besides using them in their own products. In this paper, we develop a model to understand if, when and how a firm should share its innovation with a rival. Our conclusions lead to a nuanced understanding of form of licensing as a lever for controlling competition in product markets.

■ SA33

Level 2 - Room 211C

Railway Applications Section (RAS) Student Paper Award

Sponsor: Railway Applications

Sponsored Session

Chair: Juan Morales, Manager Operations Research, BNSF Railway, 2400 Western Center Blvd, Fort Worth, TX, 76131, United States of America, Juan.Morales@BNSF.com

1 - Student Paper Award

Juan Morales, Manager Operations Research, BNSF Railway, 2400 Western Center Blvd, Fort Worth, TX, 76131, United States of America, Juan.Morales@BNSF.com

Finalists of the 2013 RAS Student Paper Award will present their work in this session. Finalists were not determined prior to the abstract submission deadline of the printed programs.

2 - Balanced Train Crew Assignment in Double-ended District

Yutian Yang, University of Texas at Austin, Austin, TX, United States of America, robert.yyt@gmail.com

Crew scheduling problems in railways involve assigning crew members to scheduled trains at minimum cost while satisfying agreements with labor unions and particular operational policies in railroad companies. In this paper, we develop an optimization model and heuristic algorithms to solve crew assignment in double-ended districts with workload balance requirements which aim to evenly allocate workload across crew pools. We also study two rotation key policies which determine the dispatching order of crews in crew pools. We present the computational study on the real-life data arising from a major North American railroad company.

3 - Smooth and Controlled Recovery Planning of Disruptions in Rapid Transit Networks

Luis Cadarso, Technical University of Madrid, Pza. Cardenal Cisneros, 3, Madrid, 28040, Spain, luis.cadarso@upm.es

This paper studies the integrated timetabling and rolling stock re-scheduling problem for disruption management in rapid transit rail networks. We consider passenger behavior while minimizing recovery time and schedule changes, which measure the quality of the recovery plan. We report computational tests on instances of the Spanish rail operator RENFE.

4 - A Macroscopic Timetable Rescheduling Approach for Large Scale Disruptions

Lucas P. Veelenturf, Rotterdam School of Management and ECOPT, Rotterdam, Netherlands, lveelenturf@rsm.nl

On a daily basis railway operations have to deal with disruptions in the network characterized by partial or complete blockages of open track sections. These disruptions often continue for some hours. Train services need to be cancelled and others need to be delayed in order to compensate for the loss of network capacity. In particular, such disruptions typically lead to infeasibilities in the planned timetable, the rolling stock allocations and the crew duties. This requires the railway operator and the infrastructure manager to reschedule the timetable, and the rolling stock and crew schedules. In this research we focus on the rescheduling of the timetable at a macroscopic level. The formulation minimizes the number of cancelled and delayed trains while adhering to capacity constraints on the tracks and within the stations. The model ensures that there is rolling stock available for all trains in the resulting timetable.

■ SA34

Level 2 - Room 211D

Simulation Optimization

Sponsor: Simulation Society

Sponsored Session

Chair: Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, 119260, Singapore, iseleelh@nus.edu.sg

Co-Chair: Enlu Zhou, Assistant Professor, University of Illinois at Urbana-Champaign, 201D Transportation Bldg., 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, enluzhou@illinois.edu

1 - Learning Logistic Demand Curves in Business-to-Business Pricing

Huashuai Qu, University of Maryland, 1305 Mathematics Building, University of Maryland, College Park, MD, 20742, United States of America, huashuai@umd.edu, Michael Fu, Ilya Ryzhov

We propose an approximate Bayesian model for predicting the win/loss probability for a given price in business-to-business pricing. This model allows us to learn parameters in logistic regression based on binary data and can be quickly updated after each new observation. We also derive an approach for price bidding, allowing decision-maker to achieve multiple objectives by integrating the uncertainties. We test the statistical model and the bidding strategy with synthetic and real data.

2 - An Intelligent Augmentation of Particle Swarm Optimization with Ensemble of Metamodels

Mengqi Hu, Assistant Professor, Mississippi State University, PO Box 9542, 260 McCain Hall, Mississippi State, MS, 39762, United States of America, mhu@ise.msstate.edu

In this research, we propose to augment Particle Swarm Optimization (PSO) via the fusion of ensemble of metamodels for simulation optimization which is termed as PSO-EM. An ensemble of metamodels which combines multiple stand-alone metamodels is adaptively developed to replace the computational expensive simulation model. The performance of the proposed PSO-EM is tested on several benchmark functions, and the results demonstrate that PSO-EM outperforms several state-of-the-art PSO algorithms.

3 - The Gradient Oriented Multi-objective Simulation Optimization Search Algorithm

Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, 119260, Singapore, iseleelh@nus.edu.sg, Ek Peng Chew, Haobin Li

With dominated hyper-volume serving as the search improvement indicator, this research work incorporates gradient information of a multi-objective optimization problem into a generalized stochastic search framework, aiming to achieve high efficiency without losing necessary exploration of the search space. It is designed as a transferrable approach that every search algorithm conforms to the framework can apply. Numerical examples are presented to show the effectiveness of the method proposed.

4 - Sequential Procedures for Large-Scale Ranking-and-Selection Problems in Parallel Simulation Schemes

Jun Luo, Shanghai Jiao Tong University, Add. 535 Fahua Zhen Rd., Shanghai, 200052, China, jluo_ms@sjtu.edu.cn, Yang Wu, Jeff Hong, Barry Nelson

Many sequential R&S procedures are designed to be implemented in a single-processor simulation environment. However, parallel computing, such as multi-core Desktops and many-core servers, is ubiquitous. "What makes sequential procedures on multiple processors different from that on a single processor?" is a critical question we intend to answer. We first identify the potential issues of simply executing existing procedures in parallel and then provide two approaches to address these problems.

■ SA35

Level 2 - Room 212A

Economics of Information Systems

Sponsor: E-Business

Sponsored Session

Chair: Zhiling Guo, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong - PRC, zhiling.guo@cityu.edu.hk

1 - The Mediating Role of Electronic Word-of-Mouth between Firms' Strategic Actions and Performance

Ling Xue, University of North Carolina at Greensboro, Greensboro NC 27402, United States of America, l_xue@uncg.edu, Cheng Zhang, Zhe Qu, Peijian Song

We address two research questions: (1) how do customers respond to firms' strategies by their e-WOM behavior and (2) how does customers' e-WOM behavior channel the impact of firms' strategic actions on their performance. Our empirical findings show that e-WOM generates an important chain effect between firms' strategic actions and their performance, and that the effect of firms' strategic actions on e-WOM is moderated by firms' online popularity.

2 - Checking in to Check it Out: An Empirical Analysis of Customers' Engagement on Location Based Social

Lei Wang, PhD Candidate, University of Connecticut, 2100 Hillside Road Unit 1041, Storrs, CT, 06269, United States of America, Lei.Wang@business.uconn.edu, Ram Gopal, Ramesh Sankaranarayanan, Joseph Pancras

Retailers are increasingly utilizing location-based services via mobile devices to enhance customer engagement. Based on a unique dataset of location-based services (Foursquare and Yelp) for restaurants in New York City, we utilize cross-sectional analyses and find that customer engagement exhibits spatial interdependency that persists over time. Our time-series analysis shows that spatial correlation dissipates with distance, indicating a strong agglomeration effect in restaurant industry.

3 - An Experimental Study of Penny Auctions

Zhiling Guo, Associate Professor, Singapore Management University, School of Information Systems, Singapore, Singapore, zhilingguo@smu.edu.sg, Ben Liu

Penny auction is a special form of business-to-consumer online auction that turns shopping into a competitive bidding game. Based on controlled lab experiments, this study evaluates how budget, risk attitude, and strategic thinking of consumers would affect their bidding strategies. We found evidences that penny auction is a profitable selling mechanism only under certain conditions. We further identify a number of factors that impact auctioneer revenue and bidders' performance in the auction.

■ SA36

Level 2 - Room 212B

Network Diffusion and Infectious Disease Control

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Hugh Medal, Assistant Professor, Mississippi State University, 260 McCain Engineering Building, Mississippi State University, MS, 39762, United States of America, hugh.medal@msstate.edu

1 - Optimizing Provider Recruitment for Public Health Surveillance Networks

Samuel Scarpino, Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM, United States of America, scarpino@utexas.edu, Lauren Ancel Meyers, Nedialko Dimitrov

Public health agencies use surveillance systems to detect and monitor diseases. These systems often rely on data sources that are chosen based on loose guidelines or out of convenience. Here, we present a new, data-driven method for designing surveillance systems. Our approach is a geographic optimization of data sources designed to achieve specific surveillance goals. The resulting networks outperformed existing systems when predicting seasonal and pandemic influenza hospitalizations.

2 - Automatically Generating Public Policies from Contact Networks

Mario Ventresca, University of Toronto, 5 King's College Rd., Toronto, Canada, mario.ventresca@utoronto.ca, Dionne Aleman

A goal of understanding diffusion of infectious diseases through a population is to create better public health policies to mitigate the disease. We present an approach that utilizes machine learning methods as a means to automatically propose such policies from identified critical nodes to vaccinate in a contact network representation of the Greater Toronto Area. The network is constructed from publicly available census data, and is easily adapted to other populations.

3 - A Cutting-plane Algorithm for Solving a Weighted Influence Interdiction (Bilevel) Problem

Soheil Hemmati, Ph.D. candidate, University of Florida, 406 Weil Hall, University of Florida, Gainesville, FL, 32611, United States of America, soheilmn@ufl.edu, My T. Thai, J. Cole Smith

Social networks, computer networks, etc., are examples of real-world networks in which an attacker may try to exploit the network structure in order to propagate some type of influence such as rumors, infections, etc. over the nodes. We consider a scenario in which we can protect the nodes from being the source of such malicious influence propagation. We suggest a mixed-integer bilevel program, a set of valid inequalities, and an exact algorithm tailored for the problem.

4 - Data-driven Dynamic Networks of HIV Transmission

Benjamin Armbruster, Northwestern University, 2145 Sheridan Road, Evanston, Il, United States of America, armbruster@northwestern.edu

We describe how to create a consistent and accurate simulation of how a sexual network changes over time using ego-centric network data collected from a longitudinal survey. We then add HIV transmission to the model and use it to address various questions of interest. The data is from a survey of young men who have sex with men in Chicago. We describe how to overcome the key challenge: determining an accurate model for the formation of new partnerships.

■ SA37

Level 2 - Room 213A

Contemporary Scheduling

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Joseph Leung, Distinguished Professor, New Jersey Institute of Technology, Department of Computer Science, University Heights, Newark, NJ, 07102, United States of America, joseph.y.leung@njit.edu

1 - Motivations, Models and Algorithms for Scheduling with Multitasking

Nicholas G. Hall, Ohio State University, 2100 Neil Avenue, 658 Fisher Hall, Columbus, OH, 43210-1144, United States of America, hall_33@fisher.osu.edu, Chung-Lun Li, Joseph Y.-T. Leung

We consider scheduling environments with multitasking. We study how the motivation for multitasking affects how multitasking influences a simple scheduling system. For each motivation, we study the solvability of three of the most widely studied and practical classical scheduling problems. We provide a fast optimal algorithm or an intractability result. For the latter case, we describe simple heuristic approaches and demonstrate computationally that they provide close to optimal solutions.

2 - Approximation Algorithms for Bi-criteria Scheduling with Machine Assignment Cost

Kangbok Lee, Research Associate Professor, Rutgers University, Business School, Piscataway, NJ, United States of America, kangblee@business.rutgers.edu, Joseph Leung, Michael Pinedo

We consider a bi-criteria parallel machine scheduling problem in which the first objective is to minimize the makespan for the total completion time and the second objective is to minimize the maximum machine cost or the total machine cost. We propose fast heuristics and establish their worst-case performance bounds.

3 - Competitive Two-agent Scheduling with Simple Linear Deterioration

Lixin Tang, Professor, Northeastern University, The Logistics Institute, Shenyang, 110819, China, lixintang@mail.neu.edu.cn, Xiaoli Zhang

This paper considers a scheduling simultaneous with two-agent and simple linear deterioration. Two agents compete to process their respective jobs on common machine and each agent has his own criterion to optimize. The goal is to determine a schedule for two agents' jobs such that the objective of one agent is minimized while keeping the objective of the other agent no exceeding a maximum value. We obtain different problems complexities of various scheduling environments.

4 - Identification of Primary Bottleneck Clusters in a Job Shop

Jun-qiang Wang, Professor, Northwestern Polytechnical University, Box 554,Northwestern Polytechnical University, 127 Youyi Xilu, Xi'an, 710072, China, siemwjq@gmail.com, shudong sun, yingfeng zhang, yong kang, Jian Chen, George Q. Huang

Clearly distinguishing between bottlenecks and non-bottlenecks, as well as scientifically identifying the significance of each bottleneck, is a difficult task in a job shop. We propose a identification model of primary bottleneck cluster (PBC) to determine the exact size, importance, and hierarchy of bottleneck candidates, and use hierarchical clustering and TOPSIS to identify multi-order PBCs. Feature attributes of Machines and distance metric of clustering impact PBC identification.

5 - Subcontracting Operations with Multiple Manufacturers and a Single Third Party

George Vairaktarakis, Professor, Case Western Reserve University, CWRU, Cleveland, OH, United States of America, gxv5@case.edu, Vernon Ning Hsu, Ke Fu

Consider a set of manufacturers who have the option to subcontract part of their workload to a third party, so as to improve their individual production cost: in-house unit production cost + unit cost at the third party + completion time cost. This time sensitivity, together with the limited capacity at 3P present an interesting optimization problem for which we provide algorithms even for the case of varying speeds for the processing of the various manufacturer workloads at the 3P facility.

■ SA38

Level 2 - Room 213B

Deterministic Algorithms for Multiobjective Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Margaret Wiecek, Clemson University, Mathematical Sciences, Clemson, United States of America, wmalgor@clemson.edu

1 - Decentralized Computation of Pareto Points in Multi-objective Optimization

Brian Dandurand, Clemson University, Department of Mathematical Sciences, Clemson, SC, 29634, United States of America, bdandur@clemson.edu, Margaret Wiecek

Solution generation for multiobjective optimization problems (MOPs) available through MOP subproblems require distributed solution approaches subject to restricted coordination of subproblem solutions. Algorithms are stated and analyzed for convergence based on the adaptation, extension, and integration of existing theory of Gauss-Seidel methods, augmented Lagrangian coordination, and MOP solution techniques. Applications and examples are given.

2 - Preserving Efficiency in Multiobjective Programming under Uncertainty

Margaret Wiecek, Clemson University, Mathematical Sciences, Clemson, United States of America, wmalgor@clemson.edu, Erin Doolittle, Hervé Kerivin

Multiobjective programs with uncertain objective functions are studied. The uncertainty is reflected in the number of objective functions, that can be infinite, and their type that results from operation applied to a subset of essential objective functions. Operations on the essential functions that have no effect on their Pareto set are identified.

■ SA39

Auditorium 3

JFIG Paper Competition I

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Erhun Kundakcioglu, Assistant Professor, Ozyegin University, Nisantepe District, Orman Street, Istanbul, Turkey, erhunk@gmail.com

Chair: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering, Fayetteville, AR, 72704, United States of America, shengfan@uark.edu

1 - JFIG Paper Competition

Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering, Fayetteville, AR, 72704, United States of America, shengfan@uark.edu

Papers are submitted for this year's JFIG paper competition, and each one is evaluated based on the importance of the topic, appropriateness of the research approach, and the significance of research contribution. In this session, finalists-selected in two rounds of review, will present their papers. For the selected finalists and the abstracts of the selected papers, please refer to the online program.

■ SA40

Auditorium 2

Transportation Procurement Auctions

Cluster: Auctions

Invited Session

Chair: Monia Rekik, Associate Professor, Laval University, 2325 Rue de la Terrasse, Quebec, QC, G1V0A6, Canada, Monia.Rekik@cirrelt.ca

1 - A Semantic Model for Multi-attribute Transportation Procurement Auctions

Hichem Klabi, LARODEC, Tunis, Tunisia, Hichem.klabi@isg.rnu.tn, Monia Rekik, Sehl Mellouli

A number of studies showed the importance of considering attributes other than the price to select carriers. This talk identifies the most important attributes (through an exhaustive study of the recent litterature) and proposes a calssification of them trough a semantic model. We show the importance of considering this semantic model when solving the winner determination problem for the carriers' selection in transportation procurement auctions.

2 - Reputation-based WDP in Collaborative Transportation Auctions

Intissar Ben Othmane, Laval University, 2325 Rue de la Terrasse, Quebec City, QC, G1V0A6, Canada, intissar.ben-othmane.1@ulaval.ca, Sehl Mellouli, Monia Rekik

We consider a context in which shippers participate in a centralized combinatorial auction. The carriers are the only bidders of the auction and are permitted to submit shipping contracts requested by different shippers in the same package bid. We address the winner determination problem in a context where the winners are determined based not only on the ask price but also on the carriers reputation that may be different from one shipper to another.

3 - Short-term Allocation of Shipping Contracts in Strategic Transportation Procurement Auctions

Yassin Feki, Laval University, 2325 Rue de la Terrasse, Montreal, QC, Canada, fekihyassin@gmail.com, Adnene Hajji, Monia Rekik

We consider a context where the strategic selection of TL carriers uses a combinatorial auction mechanism. We address the problem of allocating shipping contracts to these strategic carriers at the operational level where the objective is to minimize not only transportation costs but also inventory and backorder costs. In this case, one should manage the tradeoff between using the strategic carriers with which the shipper already engage on at the strategic level and spot carriers.

4 - Solving Winner Determination Problems for Combinatorial Transportation Auctions with Uncertainty

Monia Rekik, Associate Professor, Laval University, 2325 Rue de la Terrasse, Quebec, QC, G1V0A6, Canada, Monia.Rekik@cirrelt.ca, Nabila Remli, Issmail ElHalaoui

We consider a winner determination problem for combinatorial transportation procurement auctions in a context where shipment volumes are not known with certainty. Based on the bi-level characteristic of the problem, a 2-stage robust formulation is considered and solved using a constraint generation algorithm. A number of accelerating procedures are also tested to improve solution times for large problems. Experimental results show a good performance of the proposed approach.

■ SA41

Level 1 -101A

Product Variety and Consumer Choice

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Aydin Alptekinoglu, Associate Professor of Supply Chain Management, Pennsylvania State University, University Park, PA, United States of America, aydin@psu.edu

1 - Can There Be Too Much Variety? Limits of Mass Customization

Eren Cil, Assistant Professor, University of Oregon, 1208 University of Oregon, Eugene, OR, 97403-1208, United States of America, erencil@uoregon.edu, Michael Pangburn

Firms employ mass customization to closely match customers' taste with the delivered product. In this paper, we additionally consider the brand-level issue of mismatch between customers' tastes and the firm's full range of products. We show that the resulting limit of mass customization, even when costless to the firm, is bounded. We also show that the firm should serve extreme-taste consumers via fixed and lower-priced niche outlier products that are not subject to customization.

2 - Joint Stocking and Assortment Planning under the Nested Logit Model

W. Zachary Rayfield, Cornell University, Ithaca, NY, United States of America, wzr2@cornell.edu, Paat Rusmevichientong, Huseyin Topaloglu

We study a joint inventory replenishment and assortment offering problem where customers choose among the set of offered products according to the nested logit model. We show that optimal offer assortments have a desirable structure that arises from ordering products by popularity.

3 - Managing Customer-Induced Variability in Service Operations: The Role of Requisite Variety

Enrico Secchi, Assistant Professor, University of Victoria, PO Box 1700 STN CSC, Victoria, BC, V8W 2Y2, Canada, esecchi@uvic.ca, Aleda Roth, Rohit Verma

We examine the influence of service improvisation on various types of customer-induced variability. Using a sample of hotel managers, we test the effectiveness of such service operations strategies. We show that empowering employees to deviate from standard processes (i.e., improvising) is cost-effective in some service types but counterproductive in others.

4 - The Exponomial Choice Model

Aydin Alptekinoglu, Associate Professor of Supply Chain Management, Pennsylvania State University, University Park, PA, United States of America, aydin@psu.edu, John Semple

We propose a new discrete choice model and explore its implications for pricing and assortment planning. Greatly facilitated by the fact that the loglikelihood function is concave in the unknown parameters, we estimate our model and compare it with multinomial logit on real choice data.

■ SA42

Level 1 -101B

Empirical Research in Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Suresh Muthulingam, Assistant Professor, Cornell University, 401p Sage Hall, Ithaca, NY, 14853, United States of America, sm875@cornell.edu

1 - The Role of Retail Competition within Distribution Networks

Xiang Wan, University of Tennessee, Department of Marketing and Supply Chain, Knoxville, United States of America, xwan6@utk.edu, Nicole DeHoratius

We explore how retail competition –it magnitude and type - impacts key characteristics of a distribution channel such as variety, inventory, and pricing. Using data from a US based distributor of consumer goods, we observe the level of competition within specific geographic markets and identify factors correlated with this degree of market competition.

2 - The Effect of External Triggers on the Adoption of Environmental Improvements

Enno Siemsen, Associate Professor, University of Minnesota, 3-150 Carlson School of Management, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu, Suvrat Dhanorkar, Kevin Linderman

Regulatory Institutions and Intermediary Agencies monitor, enforce and trigger environmental improvement. While government regulators exercise formal authority, local intermediaries depend on influence tactics. Using data from over 180 field projects, we analyze the delay in adoption of environmental recommendations, and contrast the ability of environmental regulators to coerce firms through inspections versus the ability of intermediary agencies to influence firms through systematic reminders.

3 - Consumer Perceptions of Remanufactured Products

Ravi Subramanian, Associate Professor, Scheller College of Business, Georgia Institute of Technology, 800 West Peachtree St. NW, Atlanta, GA, 30308, United States of America, ravi.subramanian@scheller.gatech.edu, Ramanath Subramanyam

Using data on product purchases, we compare post-purchase consumer perceptions of remanufactured and new products. Our findings are key to closed loop supply chain research and practice because of the supposed equivalence in the performance of remanufactured and new products.

4 - Does Forgetting Affect Vendor Quality Performance? – An Empirical Investigation

Suresh Muthulingam, Assistant Professor, Cornell University, 401p Sage Hall, Ithaca, NY, 14853, United States of America, sm875@cornell.edu, Anupam Agrawal

We examine how forgetting impacts the quality performance of vendors using data on 2,732 quality improvement initiatives undertaken by a manufacturer at its vendors. Forgetting depreciates over 13% of quality gains obtained from quality improvement initiatives (induced learning) and over 16% of quality gains from learning-by-doing (autonomous learning) every year. We also highlight which type of quality initiatives lead to sustained quality gains and shed new light on quality management.

■ SA43

Level 1 -101C

Supply Chain Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Elodie Adida, University of California at Riverside, elodie.goodman@ucr.edu

1 - Efficiency of Supply Chains under Imperfect Competition and Nonlinear Demand

Georgia Perakis, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, United States of America, georgiap@mit.edu, Wei Sun

We study a two-tier supply chain where a supplier offers price-only contracts to asymmetric retailers facing nonlinear demand. We quantify the decentralized supply chain performance in terms of channel profit, market penetration, social welfare and rent extraction. We show that retailer asymmetry deteriorates performance while competition improves efficiency but the inefficiency is smaller when demand is concave rather than convex.

2 - Competition and Coordination in a Two-channel Supply Chain

Amy David, University of Illinois at Chicago, 1615 Monroe Street, #1S, Evanston, IL, 60202, United States of America, amydavid@uic.edu, Elodie Adida

We study competition and coordination in a supply chain in which a single supplier both operates a direct channel and sells its product through multiple independent retailers competing in quantities. We find that the two-channel supply chain may be subject to inefficiencies not present in the traditional supply chain, and suggest tactics for remediation.

3 - Vertical Integration in Supply Chain Networks

Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, M5S 3E6, Canada, Ming.Hu@Rotman.Utoronto.Ca, Awi Federgruen

We analyze supply chain networks where at each echelon suppliers compete to sell multiple products to firms at the next echelon. The offered products are differentiated and the firms in each echelon engage in price competition. We use the model to evaluate the impact of vertical integration on equilibrium prices and product assortments.

4 - Alliance Formation for Durable Products

Yuhong He, Ph.D. Student, University of California, Irvine, 1334 Verano Plac, Irvine, CA, 92617, United States of America, hhe08@exchange.uci.edu, Shuya Yin, Saibal Ray

We consider a two-period model involving a value chain comprising two upstream firms (selling complementary goods) and one downstream firm (selling a durable end product). We are interested in understanding the role of the end product durability and consumer behaviors (forward-looking and/or patient to wait and buy in the future) in shaping the incentives of the upstream firms to form an alliance.

■ SA44

Level 1 -101D

Sourcing, Procurement, and Entry Strategies

Sponsor: Manufacturing & Service Operations Management/ Supply Chain

Sponsored Session

Chair: Cuihong Li, University of Connecticut, 2100 Hillside Rd., Storrs, CT, 06269, United States of America, Cuihong.Li@business.uconn.edu

1 - Optimal Procurement Auction with Sequential Supplier Qualification

Wei Chen, University of Texas-Dallas, Richardson, TX, United States of America, wxc103020@utdallas.edu, Milind Dawande, Ganesh Janakiraman

A firm is soliciting price bids for a sourcing contract from N suppliers. The contract can only be awarded to a supplier who passes two rounds of qualification/testing, which can be performed sequentially or simultaneously. We study a two period optimal mechanism design problem in which some suppliers take the first test in the first period and some among the successful take the second test in the second period, and some of the untested suppliers take the integrated test in the second period.

2 - Entry Deterrence Strategies Facing Capacitated Competition

Huaqing Wang, University of Miami, Miami, FL, United States of America, h.wang12@umiami.edu, Haresh Gurnani, Murat Erkoc

We study a model in which a monopolistic incumbent faces entry of a capacitated entrant. As function of the entrant's capacity, the incumbent can adopt different strategies to deter or accommodate the entrant. We show that when entry is inevitable, the capacitated entrant (incumbent) can get higher profit in Stackelberg competition as follower (leader) than in Nash Competition. We also consider a case in which the incumbent invests in changing consumers' product preference.

3 - The Effect of Entrant Cost Uncertainty in Procurement Auctions

Brendan See, Ph.D. Candidate, Industrial and Operations Engineering, University of Michigan, Ann Arbor, United States of America, bdsee@umich.edu, Damian Beil, Izak Duenyas

Although an incumbent supplier may know her cost to produce an item, an entrant supplier is usually less informed. We model this scenario and allow the entrant to learn additional information at a cost. The buyer can influence the learning cost. We study whether the entrant will learn prior to the auction or delay learning and make a less-informed bid. Further, we evaluate when the buyer will exert effort to lower the entrant's learning cost.

4 - Single Sourcing vs Multisourcing

Sameer Hasija, Insead, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, sameer.hasija@insead.edu, Shantanu Bhattacharya, Alok Gupta

We compare two strategies for service outsourcing: multisourcing and single-sourcing. Our focus is to identify the interplay between effort distortion and free-rider issues in determining the optimal strategy.

5 - Supply Base Design with Supplier Competition and Improvement Effort

Cuihong Li, University of Connecticut, 2100 Hillside Rd., Storrs, CT, 06269, United States of America, Cuihong.Li@business.uconn.edu

We consider a buyer sourcing from a number of suppliers. The suppliers invest in cost reduction before they compete for the contract based their costs. We analyze when supplier competition encourages or discourages their cost-reduction efforts, and how to design the supply base considering such effects.

■ SA45

Level 1 -101E

Topics in Sustainable Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Sang Kim, Associate Professor, Yale University, New Haven, CT, 06520, United States of America, sang.kim@yale.edu

1 - Efficient Feed-in-Tariff Policies for Renewable Energy Technologies

Saed Alizamir, PhD Student, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, saed.alizamir@duke.edu, Francis de Véricourt, Peng Sun

This paper provides insights and guidance into designing effective and cost-efficient Feed-In-Tariff policies to promote deployment of renewable energies. We propose a dynamic optimization modeling framework with learning and diffusion effects, and characterize the structure of the optimal policy. We compare this structure against the current practice of FIT-implementing jurisdictions, and show how it depends on technology and market characteristics.

2 - Shared Transportation Systems: Bike Sharing

Ashish Kabra, INSEAD, Fontainebleau, France, ashish.kabra@insead.edu, Serguei Netessine, Francis de Véricourt, Karan Girotra

Shared urban transportation systems have the potential to reduce urban pollution, relieve traffic congestion and increase economic activity in cities, while offering the convenience of personally owned vehicles. We analyze data from over 25 major bike sharing systems and estimate customer adoption and use in response to system design, operation and performance. We use our estimates to identify station design and optimal launch strategies.

3 - Designing Subsidies: Commitment vs. Flexibility

Ruben Lobel, University of Pennsylvania, The Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu, Maxime Cohen, Georgia Perakis

We study how policy adjustments in subsidy programs (e.g. solar panels) interact with production decisions. We model the interaction between a government and an industry player in a two-period game setting under uncertain demand. We show how the timing of decisions will affect the cost of the subsidy program. In particular, we show that when the government commits to a fixed policy, it spends less on the subsidy program because it signals the supplier to produce more in the earlier stage.

4 - Incentives for Prevention and Remediation of Random Compliance Violations

Sang Kim, Associate Professor, Yale University, New Haven, CT, 06520, United States of America, sang.kim@yale.edu

We consider a setting in which a regulator performs inspections on a production facility owned by a firm to ensure environmental compliance. The firm may disclose random occurrences of compliance violations and/or exert costly effort to prevent and mitigate the impact of the violations. The regulator sets the inspection rate and the penalty in order to minimize the long-run social cost. We characterize the equilibrium of this game and study the impact on the environment and the social cost.

■ SA46

Level 1 -101F

Dynamic Programming in Operations Management and Real Options

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Selvaprabu Nadarajah, PhD Candidate, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, snadaraj@andrew.cmu.edu

Co-Chair: Nicola Secomandi, Associate Professor, Carnegie Mellon Unversity, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ns7@andrew.cmu.edu

1 - Subgradient Bounds for Convex Dynamic Programs

David Brown, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, dbbrown@duke.edu, Jim Smith

We study the use of information relaxations and penalty functions to compute bounds on the performance of an optimal policy for convex stochastic dynamic programs. We develop two penalty functions, both based on subgradients of approximate value functions. We study properties of the resulting bounds and show that the approach can, in theory, lead to tight bounds. Finally, we demonstrate the method on some challenging applications, including inventory control with lost sales and long lead times.

2 - Pricing Commodity Contingent Revolvers for Hedging Commodity Based Real Options

Mathew Thompson, Associate Professor, Queens School of Business, Queens University, Kingston, ON, K7L 3N6, Canada, mthompson@business.queensu.ca

Commodity contingent revolvers (CCRs) are credit vehicles used by firms to manage the margin risk that results from losses in their hedging portfolios. Assets with real optionality, require dynamic hedging strategies. The pricing of real options CCRs require a priori knowledge of the optimal exercise and hedging strategy. This paper presents the first method for pricing CCRs based on dynamic hedging strategies with multi-factor, multi-commodity futures price models.

3 - Switching Options in Peak Power Plants: Empirical Evidence

Stein-Erik Fleten, Norwegian University of Science & Technology, Dept of Ind Econ & Tech Mgmt, Trondheim, Norway, stein-erik.fleten@iot.ntnu.no, Carl Ullrich, Erik Haugom, Alois Pichler

We analyze the real options to shutdown, startup and abandon peak power plants. We assume that the plants' status for a given year is either ready to operate, in standby or retired. The analysis is made using data for 1,121 individual power plants for the period 2001–2009. The results indicate that plant managers have decision heuristics that take uncertainty into account in a manner consistent with real options theory.

4 - Relaxations of Approximate Linear Programs for the Real Option Management of Commodity Storage

Selvaprabu Nadarajah, PhD Candidate, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, snadaraj@andrew.cmu.edu, Nicola Secomandi, Francois Margot

The real option management of commodity conversion assets gives rise to intractable Markov decision processes (MDPs). This intractability is due primarily to the high dimensionality of a commodity forward curve in the MDP state. We develop a novel approximate dynamic programming approach based on relaxations of approximate linear programs. Focusing on natural gas storage, we provide theoretical and numerical support for the proposed approach.

■ SA47

Level 1 -101G

Service System Capacity, Control, and Performance: Case Managers, Sales, Call Centers, Scrip Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Noah Gans, University of Pennsylvania, Philadelphia, PA, United States of America, gans@wharton.upenn.edu

1 - Queuing Models of Case Managers

Fernanda Campello de Souza, PhD Student, University of Alberta, 9917 110 Street, Apt. 1201, Edmonton, AB, T5K 2N4, Canada, campello@ualberta.ca, Robert Shumsky, Armann Ingolfsson

Many service systems use case managers who have repeated interactions with each customer until service is completed (e.g., emergency department doctors, social workers). We propose a stochastic model of a case manager system and formulate models that provide performance bounds for the system. We examine interactions among system parameters, including the impact on system performance of setting case-load limits. We also investigate heuristics for setting these limits.

2 - Salesforce Compensation when Agents Serve a Common Customer Queue

Elnaz Jalilipour Alishah, University of Washington, Box 353200, Foster School of Business, UW, Seattle, WA, 98195-3200, United States of America, jalilipo@uw.edu, Hamed Mamani, Yong-Pin Zhou

We study salesforce compensation issues when two independent agents get customers from a common customer queue. When agents spend more time with each customer, they get higher customer satisfaction and more conversion to sales (hence compensation). At the same time, slowing down means fewer customers and longer waits for them causing disutility. We show system inefficiency in this competition model and study incentives and allocation mechanisms to induce system-optimal behavior from the agents.

3 - Customer Acquisition, Retention, and Service Quality in a Call Center

Philipp Afeche, University of Toronto, 105 St. George Street, Toronto, ON, M5S 3E6, Canada, philipp.afeche@rotman.utoronto.ca, Mojtaba Araghi, Opher Baron

We study the problem of maximizing the profit of an inbound call center that controls promotions, staffing, and priorities to new vs. base customers. We develop a deterministic fluid model that links these controls to customer flows, the size of the customer base and key performance measures. We generate analytical prescriptions on the optimal decisions for the fluid model, compare these to simulation results, and discuss the sensitivity to word-of-mouth effects and customer characteristics.

4 - Analyzing Scrip Systems

Kristine Johnson, Massachusetts Institute of Technology, ORC, Cambridge, MA, United States of America, krisdj@mit.edu, Peng Sun, David Simchi-Levi

Scrip systems provide a non-monetary trade economy for exchange of services. We model a scrip system as a stochastic game and study system design issues. We show the optimality of one particular rule to maximize social welfare. We also investigate the optimal number of scrips to issue under this rule. We show there is an upper bound on the number of scrips allowed in the system, which increases with the discount factor as well as the ratio between the benefit and cost of service.

■ SA48

Level 1 -101H

Behavioral Modeling and Studies in Business

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Tony Haitao Cui, University of Minnesota, Carlson School of Management, 321 19th Ave. S., Suite 3-150, Minneapolis, MN, 55455, United States of America, tcui@umn.edu

Co-Chair: Diana Wu, University of Kansas, Lawrence, KS, United States of America, dianawu@ku.edu

1 - Sourcing Strategy and High Impact Low Probability Disruption Response: Theory and Experiment.

Kyle Goldschmidt, Pennsylvania State University, 426A Business Building, University Park, PA, 16802, United States of America, khg116@psu.edu, Douglas Thomas, Christopher Craighead, Mirko Kremer

We study sourcing decisions in the context of high-impact, low-probability supplier disruptions. We identify two significant biases: 1) over long periods without supply disruptions, decision makers gradually reduce their supply base; and 2) after experiencing a disruption, decision makers re-adjust their supply base according to the severity of the disruption.

2 - Power and Fairness

Paola Mallucci, University of Wisconsin, Madison, WI, United States of America, mallu004@umn.edu, Diana Wu, Tony Haitao Cui

Understanding what is "fair" is central to research on fairness. While different theories have been proposed to explain how decision makers evaluate the fairness of an outcome, one important characteristic of social interaction, power, is missing from the picture. In this research, we offer laboratory evidence that power has significant impact on what is viewed as fair, and thus it should be incorporated when modeling fairness.

3 - Supply Chain Contract Design: Impact of Bounded Rationality and Individual Heterogeneity

Kay-Yut Chen, Hewlett-Packard, 3000 Hanover St., Palo Alto, CA, 94304, United States of America, kay-yut.chen@hp.com, Diana Wu

In this paper, we model several forms of non-optimizing behavior, including recency effect, reinforcement, demand-chasing and anchoring and random decision errors, in a newsvendor setting under different types of supply chain contracts. A great deal of heterogeneity is discovered, indicating the importance of calibrating contract to the individual. In addition, our analysis shows that the profitability and the effectiveness of contracts can be affected by non-optimizing behaviors significantly.

■ SA49

Level 1 -101I

Correlation Decay Method for Decision, Optimization, and Inference in Large Scale Networks

Cluster: Tutorials

Invited Session

Chair: David Gamarnik, Professor, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, 02140, United States of America, gamarnik@mit.edu

1 - Correlation Decay Method for Decision, Optimization and Inference in Large Scale Networks

David Gamarnik, Professor, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, 02140, United States of America, gamarnik@mit.edu

Many decision problems on networks involve solving hard algorithmic problems. In light of the size of many real life networks one often has to resort to faster local algorithms which can provide the required computation effort scales. The correlation decay property is a method which provides a rigorous justification for the validity of such local algorithms. In this tutorial we illustrate the applications of the correlation decay method for several applications

■ SA50

Level 1 -101J

Technological Change and Climate Change

Cluster: Climate Change and OR

Invited Session

Chair: Erin Baker, University of Massachusetts, 1600 Governors Drive, Amherst, MA, 01003, United States of America, edbaker@ecs.umass.edu

1 - Energy Technologies Evaluated Against Climate Targets

Jessika Trancik, Assistant Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02138, United States of America, trancik@mit.edu, Morgan Edwards, Mandira Roy

This research compares the dynamic performance of energy technologies to climate targets. We propose new, forward-looking metrics to evaluate the mitigation potential of energy supply technologies. When applied to technology evaluation, these dynamic metrics reveal new insights on the relative performance of candidate technologies. We show how these metrics can be used to optimize technology portfolios despite inherent uncertainty about future technology performance and climate constraints.

2 - Evidence of Heterogeneity in Technological Learning in the U.S. Electricity Industry

Ekundayo Shittu, Assistant Professor, Tulane University, 7 McAlister Dr., New Orleans, LA, 70118, United States of America, eshittu@tulane.edu, Carmen Weigelt

We investigate how technological heterogeneity affects knowledge acquisition and diffusion across evolving intra-firm and competitive inter-firm ecosystems. We use spatial and intertemporal panel data from U.S. electricity firms from 1999 to 2010 to investigate the measured approach to the adoption of renewable electricity. We find that technological heterogeneity introduces asymmetries in knowledge gain.

3 - A Real Options Approach to Optimizing Investment in Low-carbon Energy Technology Development

Emily Fertig, Postdoctoral Associate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-227, Cambridge, MA, 02139, United States of America, efertig@mit.edu

Uncertainty in technological learning is crucial to planning technology development strategies. This paper develops a real options-based stochastic dynamic programming method for optimizing investment in low-carbon energy technology development under uncertainty in the effectiveness of both early-stage R and D and learning-by-doing (LBD). Results indicate that imminent deployment, high cost, lower exogenous cost reductions, and lower program funds all promote R and D spending over LBD.

4 - Endogenous Technological Change in the DICE Integrated Assessment Model

Robert Barron, University of Massachusetts Amherst, 219 Elab Building, Amherst, MA, United States of America, barron@engin.umass.edu

Many integrated assessment models neglect Induced Technological Change (ITC). We propose a means of modeling ITC within the Dynamic Integrated Model of the Climate and Economy (DICE). We find that the deployment and cost breakdown (between integration and technology costs) of solar photovoltaics are sensitive to returns to scale. These findings have important implications for the value of information with respect to integration costs and the optimal allocation of R&D resources..

■ SA51

Level 1 -102D

Environmental Tradeoffs in Transportation Decisions

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Javier Faulin, Full Professor, Public University of Navarra, Los Magnolios Blg., First floor, Pamplona, 31006, Spain, javier.faulin@unavarra.es

1 - Environmental and Economic Concerns in Time-dependent Vehicle Routing

Yixiao Huang, Tsinghua University, Department of Industrial Engineering, Tsinghua University, Beijing, 100084, China, huangyx12@mails.tsinghua.edu.cn, Lei Zhao, Jean-Philippe Gross, Tom van Woensel

Traffic conditions vary in time during the day and also differ in regions within the city. Fuel consumption and carbon emissions are associated with both travel distances and loads of the delivery truck. In this talk, we study the time-dependent vehicle routing problem under environmental and economic concerns, together with a careful examination on the data under the logistics and traffic situations in Beijing.

2 - Optimal Staging Area Locations and Material Recycling Strategies for Sustainable Highway Reconstruction

Ryan Smith, University of Illinois, Champaign, IL, United States of America, smith103@illinois.edu

Sustainable highway reconstruction requires strategies that optimally procure material from supply locations, select locations to process material, and ship material to their demand locations to reduce the consumption of energy and material resources. Our model determines (i) optimal locations for fixed and mobile staging areas, and (ii) material recycling and shipment strategies.

3 - Exploring the trade-off between Emission and Travel Time in Daily Transport Related Choices

H. M. Abdul Aziz, Ph.D. Candidate, Purdue University, 150 Arnold Dr. Apt. 15, West Lafayette, IN, 47906, United States of America, haziz@purdue.edu, Satish Ukkusuri

This research explores the mechanism of travel related short-term choices that involve trade-off between emissions and travel time. We investigate the heterogeneity in trade-off values at different traffic states and different choice contexts (route vs. departure time), and the heterogeneity across the individuals due to variation in taste and pro-environmental attitudes.

4 - Horizontal Cooperation in Vehicle Routing Problems with Environmental Criteria

Javier Faulin, Full Professor, Public University of Navarra, Los Magnolios Blg. First floor, Pamplona, 31006, Spain, javier.faulin@unavarra.es, Alejandro García del Valle, Angel Juan, Scott Grasman

This contribution presents horizontal cooperation in road transportation and supports this praxis as a way of reducing distribution costs and CO2 emissions. The methodology is based on a set of well-known benchmarks for the multi-depot VRP. We analyze environmental impacts in collaborative and non-collaborative scenarios making comparisons between costs in road transportation with and without those environmental costs. Finally, this methodology is illustrated with the results of a case study.

■ SA52

Level 1 -102E

Strategic Freight Demand Models

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Jose Holguin-Veras, William H. Hart Professor, Rensselaer Polytechnic Institute, 110 8th St., Troy, NY, 12180, United States of America, jhv@rpi.edu

1 - Dynamic Model of Urban Freight Flows and Demand Formation

Hongcheng Liu, PhD Candidate, Pennsylvania State University, 240 Leonhard, University Park, PA, United States of America, hql5143@psu.edu, Terry Friesz, Bo Zhang, Tao Yao

In this paper we model congested urban freight transportation for a hypothetical urban street network in a dynamic setting. The model may be described as a dynamic spatial price equilibrium model that views freight transportation demand as derived from the spatial separation of inventories and consumption of an abstract good. We solve a numerical example.

2 - An Optimization Model for Supplier Selection

Zahra Pourabdollahi, PhD Student, University of Illinois at Chicago, 842 W. Taylor Street, Chicago, IL, 60607, United States of America, pourabdollahi.zahra@gmail.com, Kouros Mohammadian, Kazuya Kawamura

Supplier evaluation and selection is among the most critical logistics decisions in the supply chain management. In this paper, the results of an establishment survey are used to identify important criteria in evaluating and selecting a supplier from decision-making point of view. An optimization model is also developed for supplier selection for different industry sectors. The proposed model will be eventually implemented in an activity-based freight demand modeling framework for Chicago.

3 - A Dynamic Spatial Price Equilibrium Model of Integrated Production-transportation

Jose Holguin-Veras, William H. Hart Professor, Rensselaer Polytechnic Institute, 110 8th St., Troy, NY, 12180, United States of America, jhv@rpi.edu, Ning Xu, John Mitchell, Miguel Jaller

The paper introduces a dynamic spatial price equilibrium model that estimates urban freight-related flows for integrated producer-carrier operations that compete in a market where a generic commodity is traded. The model obtains the patterns of commodity flows, production levels, and delivery tours that maximize the profits of the suppliers. The optimization problem is solved with the assistance of a heuristic approach that decomposes the interrelated decisions.

4 - Entropy-Based Freight Origin-Destination Synthesis

Carlos Gonzalez-Calderon, Graduate Research Assistant, Rensselaer Polytechnic Institute, 110 8th St., JEC 4037, Troy, NY, 12180, United States of America, gonzac4@rpi.edu, Ivan Sanchez-Diaz

This investigation proposes two entropy-maximization approaches to develop tour-based urban freight demand models that estimate origin-destination matrices from traffic counts. The first approach considers multiclass traffic with a User Equilibrium condition for trucks and passenger cars in the transportation network. The second approach takes advantage of the temporal aspect of traffic counts to incorporate time effects on freight vehicle tours.

5 - Determinants and Variants in Urban Goods Demand Strategic Modeling

Jesus Gonzales-Feliu, Research Engineer, Laboratoire d'Economie des Transports, 14 Avenue Berthelot, Lyon, France, jesus.gonzales-feliu@let.ish-lyon.cnrs.fr

This paper aims to propose a methodological analysis of modelling units for urban goods from several Urban Goods Movement surveys, mainly on the basis of the modelling unit: movement and commodity. Data quality, computational effort and aggregation level are analysed. Then we propose a procedure that relates both via an analytical model. After calibrating this procedure on real data from those surveys, we propose various application cases.

■ SA53

Level 1 -102F

Container Terminal Logistics

Sponsor: Transportation Science & Logistics/Facility Logistics

Sponsored Session

Chair: Debjit Roy, Assistant Professor, Indian Institute of Management Ahmedabad, Wing 3C, Vastrapur, India, debjit@iimahd.ernet.in

1 - Integrated Scheduling Optimization of Loading and Unloading Trains at a Container Terminal

Amir Hossein Gharehgozli, Rotterdam School of Management, Postbus 1738, Rotterdam, 3000DR, Netherlands, agharehgozli@rsm.nl, Leo Kroon, René de Koster

We study the problem of loading and unloading trains at a container terminal. Trains are served by a gantry crane which spreads over all of them on parallel tracks. Multiple straddle carriers move containers from the stacking area to a drop off lane parallel to the trains and vice versa. We focus on how to sequence the gantry crane, where to drop off containers, and finally how to sequence straddle carriers. The objective is to minimize the total earliness and tardiness of trains.

2 - Queuing Approximations for the Inter-terminal Container Transportation (ITT) Problem

Nishant Mishra, Rotterdam School of Management, Erasmus University, Rotterdam, Netherlands, nmishra@rsm.nl, Debjit Roy, Jan-Kees van Ommeren

We propose novel queuing approximations for the ITT problem where multiple container terminals use a common fleet of vehicles (ALV, AGV, multi-trailers and barges) to transport containers between terminals. Our approach is decomposition-based where we model the overall queuing network as a closed and an open queuing network, with bulk service capacities. When validating numerically using real-world and simulated data, we find that our approximations result in errors of less than 5%.

3 - Traffic Flow-based Analytical Model for Fleet and Buffer Sizing at Sea Container Terminals

Debjit Roy, Assistant Professor, Indian Institute of Management Ahmedabad, Wing 3C, Vastrapur, India, debjit@iimahd.ernet.in, Akash Gupta

The internal transport of containers in sea container terminals is performed by a pool of vehicles that share a common guide-path. We model the congestion in the vehicle guide-path using a traffic-flow based closed queuing network model and determine the fleet and buffer size to meet throughput requirements.

4 - Optimizing the Hinterland Transportation of Containers for Inbound and Outbound Flows

Stefano Fazi, School of Industrial Engineering & Innovation Sciences, Operations, Planning, Accounting, and Co, TU Eindhoven, Eindhoven, Netherlands, S.Fazi@tue.nl, Tom van Woensel, Jan Fransoo

The hinterland container supply chain, from ports to inland terminals, entails the allocation of containers to different means of transport, considering their costs, capacity and speed. We present a model that optimizes the allocation of containers, both in and out the port, in order to guarantee an effective transportation and a good utilization of the fleet.

5 - Cargo Driven Container Logistics: A Cross-Docking Facility Location Problem with Economies of Scale

Yann Bouchery, Eindhoven University of Technology, PO Box 513, Eindhoven, 5600 MB, Netherlands, y.bouchery@tue.nl, Jan Fransoo

Flow consolidation is a key aspect in container logistics as volumes are critical for economies of scale. In our research, we explore how cross-docking may improve flow consolidation by focusing on the cargo inside the containers. We thus propose a cross-docking facility location problem for container logistics in a hub-and-spoke network. Moreover, we model flow dependent economies of scale both for transportation and for cross-docking operations.

■ SA54

Level 1 -103A

Advances in V2V and V2I Modeling I: Information

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Lili Du, Assistant Professor, Illinois Institute of Technology, 3201 S. Dearborn St., Chicago, IL, 60616, United States of America, ldu3@iit.edu

1 - Computational Methods for the Dynamic Traffic Information Update Problem under Vehicle-to-Vehicle Communications

Yong Hoon Kim, Graduate student, Purdue University, 3000 Kent Ave., West Lafayette, IN, 47906, United States of America, kim523@purdue.edu, Srinivas Peeta

This study proposes an efficient vehicle-based graph theoretical approach to map the information flow to identify the dynamic traffic information update under V2V communications. The efficacy of the proposed model is demonstrated and compared with a information-based graph theoretical approach and a dynamic programming approach.

2 - Information Dissemination Delay in a Connected Vehicle Network Running on a Single Two-way Road

Lili Du, Assistant Professor, Illinois Institute of Technology, 3201 S. Dearborn St., Chicago, IL, 60616, United States of America, ldu3@iit.edu, Hoang Dao

This research proposes mathematical description models to capture information propagation delay in a connected vehicle network running on a two-way road. Intermittent wireless communication under dynamic traffic flow condition, and wireless communication interference among vehicles are integrated into the model development. The proposed models are validated are simulation experiments

3 - Approximations for Information Propagation Speed in Delay-tolerant Connected Vehicle Networks

Kai Yin, Texas A&M University, College Station, TX, United States of America, yinkai1000@gmail.com, Bruce Wang

In a delay-tolerant connected vehicle network, the message carried by vehicles propagates at vehicles' travel speed when vehicles disconnect with each other. Otherwise, the message propagates instantaneously through the multihop connectivity. In this study, we propose some approximation methods to obtain estimates of information propagation speed on bidirectional highways. The methods enable us to address not only Poisson but also general vehicle headway distributions.

4 - Instantaneous Communication Throughputs of Vehicular Ad Hoc Networks

Hao Yang, University of California, Irvine, 24 Ovation Ln, Aliso Viejo, CA, United States of America, hyang5@uci.edu, Wen-Long Jin

In this paper, models for two types of instantaneous throughputs of VANETs, broadcast and unicast, are analytically derived with a protocol communication model along discrete and continuous traffic streams. They are validated with Monte Carlo simulations. We find that throughputs are unimodal functions in both percentage of senders and transmission range and can be significantly impacted by vehicular traffic patterns and other factors.

■ SA55

Level 1 -103B

Evacuation and Emergency Response

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Andres L. Medaglia, Associate Professor, Universidad de los Andes, Departamento de Ingeniería Industrial, COPA, Bogota, Colombia, amedagli@uniandes.edu.co

1 - Modeling and Analysis of Evacuation under Highly-dynamic Extreme Weather Events

Hasan Manzour, University of Oklahoma, 1013 East Brooks Ave., Apt. H, Norman, OK, 73071, United States of America, smh.manzour@ou.edu, Suleyman Karabuk

We discuss characteristics of highly-dynamic extreme weather events such as tornadoes, in relation to evacuation of people in affected areas. We develop an evacuation model that captures these characteristics and generates a plan that minimizes expected number of injuries. Our model embeds a model of the weather event that probabilistically describes temporal and spatial progress. In the context of a real-world example, we discuss implications, challenges of evacuation under such weather events.

2 - Developing a Robust Model for Designing Emergency Medical Service (EMS) Systems

Mehrdad Shahabi, PhD Student, West Virginia University, 1227 Pineview Dr. Apt. 8, Morgantown, WV, 26505, United States of America, mehrdad.shahabi@gmail.com, Mohammad Sadra Sharifi

Emergency Medical Service (EMS) facilities are centers which should serve affected people after a large-scale disaster like natural disaster of large-scale terror attack. In this study, we present a mathematical model for designing EMS systems using robust optimization technique. This model can handle demand uncertainty and ensures that the designed system will work efficiently even if the worst-case scenario of demand happens.

3 - Restoration of Road Network Connectivity After a Disaster

F. Sibel Salman, College of Engineering, Koç University, Istanbul, Turkey, ssalman@ku.edu.tr, Ayse Nur Kibar

In a natural disaster road networks can be damaged and consequently some parts of the network may be disconnected.To facilitate emergency transportation, a critical subset of the blocked roads should be cleared to restore network connectivity as soon as possible. A fleet of machinery should be dispatched for this task. We define an optimization problem to generate a coordinated work schedule. The problem is to determine which blocked arcs to open and a walk for each vehicle starting at its depot that collectively cover the selected blocked arcs. The objective is to minimize the total time of the longest walk, i.e. the makespan.

■ SA56

Level 1 -103C

Joint Session ENRE/Climate: Energy, Water, and Climate Policy Modeling

Sponsor: Energy, Natural Resources and the Environment/Energy & Climate Change and OR

Sponsored Session

Chair: Vishnu Nanduri, Assistant Professor of Industrial Engineering, University of Wisconsin-Milwaukee, 3200 N. Cramer Street, Milwaukee, WI, 53211, United States of America, vishnu.nanduri@gmail.com

1 - Pareto Optimal Designs for CO2 Cap and Trade Policies on Deregulated Electricity Networks

Tapas Das, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, das@usf.edu, Felipe Feijoo

This paper presents two layers model to develop Pareto optimal designs for CO2 Cap and Trade policies. The top layer involves design of optimal cap-and-trade policy parameters over a planning horizon, and the bottom layer involves finding equilibrium bidding strategies of the competing generators while maximizing social welfare via DC-OPF.

2 - Optimal Energy Technology Portfolio in the Face of Climate Change

Olaitan Olaleye, Graduate Research Assistant, University of Massachusetts, Amherst, Room 120A, Marston Hall, Amherst, MA, 01003, United States of America, natialol@gmail.com, Senay Solak, Erin Baker

We use a multi-model framework to evaluate the effect of advancement in an energy technology portfolio including Solar, Nuclear, CCS, Bio-energy and Batteries for transportation. We find that CCS complements electricity from biomass, while most of the other technology pairs are substitutes; Nuclear projects have a large impact on near term abatement cost and portfolios without CCS have difficulty reaching full abatement. We discuss how the optimal R&D portfolio changes at different budget levels.

3 - Multiobjective Optimization and RL for Identifying Optimal Emissions and Water Taxes in Electricity

Ivan Saavedra, University of Wisconsin-Milwaukee, 3200 North Cramer Street, Milwaukee, 53211, United States of America, saavedr9@uwm.edu, Vishnu Nanduri

In this paper we develop a stochastic game model to represent the electricity market bidding problem. We use reinforcement learning (RL) based approach to find the optimal bidding strategies for the generators. We develop a designed experiment to obtain the hypothetical combination of tax rates for water and CO2 to be used in the electric power market as inputs in the stochastic game model. For each tax rate combination studied, we solve a multi-objective OPF problem using SPEA.

4 - A Cooperative Investment Decision Model for Renewable Energy

Alireza Ghalebani, PhD Student, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, alireza@mail.usf.edu, Tapas Das

Using the financial incentives, neighborhood size and demand characteristics, alternative technologies for capital equipment, and weather data as input, a MIP decision model is developed. The model determines the optimal level of investment in renewable energy production, storage, and distribution for the members, while minimizing the annual cost of energy.

■ SA57

Level 1 -103D

Uncertainty, Reliability and Maintenance in Energy Systems

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Bo Zeng, University of South Florida, 4202 East Fowler Avenue, ENC2400, Tampa, FL, 33620, United States of America, bzeng@usf.edu

Chair: Wei Yuan, IMSE, University of South Florida, Tampa, Florida,United States of America, weiyuan@mail.usf.edu

1 - Optimal Islanding Operations under the Contingency States in Power Grids

Mehdi Golari, PhD Candidate, The University of Arizona, 1250 E 10th St., Apt. 202B, Tucson, AZ, 85719, United States of America, golari@email.arizona.edu, Neng Fan

Under certain contingency states with some failed components or in the process of restoration of a failed power grid, islanding is an efficient method to isolate the failed part to prevent cascading blackout and supply the electricity to the other parts of the power system. We present a MIP model as well as efficient algorithms to solve the islanding problem.

2 - Multistage Stochastic Models for Natural Gas Contract and Maintenance Scheduling of Power Plants

Qipeng Phil Zheng, Assistant Professor, University of Central Florida, Industrial Engineering & Mngmt Systems, Orlando, FL, 32816, United States of America, qipeng.zheng@gmail.com

Due to environmental concerns and popularity of natural gas, more gas turbines will be introduced to power plants. This talk discusses multistage stochastic mixed integer models for natural gas contract and maintenance scheduling for power plants. Take-or-pay contract is modeled by reservoirs and the equipment maintenance is modeled by multistage mixed integer programs. Uncertainties are mainly from the volatile gas prices. Numerical experiments based on decomposition algorithms are shown.

3 - The Do-Not-Exceed (DNE) Limit for Wind Generation

Jinye Zhao, ISO New England, One Sullivan Rd., Holyoke, MA, United States of America, JZhao@iso-ne.com

Due to the variability of wind generation, the ISO tries to identify DNE limits, which are the maximum wind generation ranges that the power system can accommodate without sacrificing system reliability. The problem is formulated as a robust optimization problem where the objective is to find the largest uncertainty set such that the system remains feasible under the worst case realization. Assuming an affine policy, the model is converted into a bilinear programming problem.

4 - Security-Constrained Optimal Power Flow with Sparsity Control and Efficient Parallel Algorithms

Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, xsun84@isye.gatech.edu, Dzung Phan

We propose a new model for security-constrained optimal power flow problem, which can find a post-contingency corrective action with a minimum number of adjustments while achieving essentially the same minimum generation cost. We also propose a decomposition algorithm to solve the problem, which can be parallelized. Computational results are presented for several standard IEEE test systems and large-scale real-world power networks.

■ SA58

Level 1 -103E

Modeling Human/Natural Resource Interactions

Sponsor: Energy, Natural Res & the Environment/Forestry/Mining

Sponsored Session

Chair: Erin Belval, Colorado State University, Campus Delivery 1472, Fort Collins, CO, 80523, United States of America, mccowene@gmail.com

1 - Debris Flow Hazard Management via Global Optimization

Vitaliy A. Krasko, Colorado School of Mines, Engineering Hall, 816 15th Street, Golden, CO, 80401, United States of America, vkrasko@mymail.mines.edu, Timo Lohmann, Kevin McCoy, Steffen Rebennack, Paul Santi, Daniel Kaffine

Debris flows are fast moving landslides consisting of a mixture of debris which can include logs and boulders. We derive a coupled natural-social science model that provides guidance for allocation of scare management resources towards reducing the economic impacts of debris flows. We present a highly non-convex optimization problem which optimizes the allocating of scarce funds into prevention of debris flow occurrences, reduction of debris flow volume, and protection of people and property.

2 - Width-Constrained Reserve Design

Rachel St. John, PhD Student, University of Washington, Box 352650, Seattle, WA, 98195, United States of America, rkrieg@uw.edu, Sandor Toth

In wildlife conservation, it is imperative to provide corridors between patches of critical habitat. Current reserve selection models do not have the ability to control corridor width, a critical aspect particularly for large mammals. I will introduce a new optimization model that utilizes an algorithm from computational geometry in order to incorporate corridor width. An illustrative example will be used to demonstrate an application, validate the approach and to compare it to previous models.

■ SA59

Level 1 -103F

Environmental Regulations and Operations

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Krishnan Anand, Associate Professor, David Eccles School of Business, University of Utah, Salt Lake City, UT, 84112, United States of America, k.anand@utah.edu

1 - Cost-effective and Robust Strategies for Nonstructural Flood Risk Reduction in Coastal Louisiana

David Johnson, RAND Corporation, 1776 Main St., PO Box 2138, Santa Monica, CA, 90407, United States of America, djohnson@rand.org, Jordan Fischbach

Louisiana's 2012 Master Plan for a Sustainable Coast allocates $10.2B for nonstructural risk reduction measures like elevating homes and floodproofing commercial properties. Under this funding constraint, we have estimated the maximum potential for nonstructural risk reduction and the performance of various implementation plans across the coast. Pseudo-optimization is used to find cost-effective strategies; we also explore robustness to future environmental and economic uncertainties.

2 - Making Clean Water, Power, and Green Materials from Wastewater

Jing Ma, PH.D Candidate, Stanford University, Management Science and Engineering Dep, Stanford, CA, 94305, United States of America, jingma@stanford.edu, Craig Criddle, Erica Plambeck, Sebastien Tilmans

U.S. wastewater treatment infrastructure is past its design life, wastes energy. Working with two bay-area municipal utilities, we characterize optimal capacity investments and OM to profitably convert wastewater and trucked organic waste to multiple valuable products. GHG policy and water policy must be optimized jointly to incentivize socially optimal investments and operations.

3 - Does Cap-and-Trade Enable Collusion?

Francois Giraud-Carrier, PhD Candidate, University of Utah, 1655 E Center Campus Dr, Salt Lake City, UT, 84112, United States of America, f.giraud-carrier@utah.edu, Krishnan Anand

Carbon Taxes and Cap-and-Trade are the two leading approaches for pollution regulation. Proponents of Taxes have argued that Cap-and-Trade could facilitate collusion among firms via the trading mechanism, leading to suboptimal welfare outcomes. We examine this claim using a rigorous yet rich model of production and pollution under competition that allows for the possibility of collusion among firms via trading.

■ SA60

Mezzanine - 100A

Data Analytics for Decision Making

Sponsor: Data Mining

Sponsored Session

Chair: Matthew Liberatore, Professor, Villanova University, 800 Lancaster Ave., Villanova, PA, 19085, United States of America, matthew.liberatore@villanova.edu

1 - Advanced Data Analytics for Lighting Energy Savings Estimation and Visualization

Vikrant Vaze, Member Research Staff, Philips Research North America, 345 Scarborough Road, Briarcliff Manor, NY, 10510, United States of America, vikrant.vaze@philips.com

Though occupancy sensing & daylight harvesting controls are believed to have large energy savings potential, there is high variability in actual savings across customer sites. A major challenge in a reliable, site-specific assessment is the tradeoff between low cost and data accuracy. We develop a robust analytical approach based on grid-search and regression. Validation results show that believable visualizations and reliable savings estimates can be generated using inexpensive hardware.

2 - Predicting Analytics Investment Decisions

Matthew Liberatore, Professor, Villanova University, 800 Lancaster Ave., Villanova, PA, 19085, United States of America, matthew.liberatore@villanova.edu, Suzanne Clain, Carolyn Martin, Bruce Bruce.Pollack-Johnso

The increasing use of data-driven decision making is leading organizations to consider whether they should invest in analytics software and services. Are organizations in specific industries or geographies more likely to invest? Does industry competitiveness influence the decision? Are organization size, performance, and analytics maturity key influencing factors? We present predictive models for the analytics investment decision and level of investment based on data obtained from IBM.

3 - Identifying Predicting Variables for the Recent Improvements in Highway Safety

Yao-Te Tsai, PhD Student, Auburn University, 3323 Shelby Center, Auburn, AL, 36849, United States of America, yzt0007@tigermail.auburn.edu, Fadel Megahed, Stephen Swartz

Highway traffic safety has remained a leading public safety threat with significant economic impacts. We examine the root-causes for the differences in highway safety performance between states and identify which factors are associated with improved performance. We measure the efficiency and effectiveness of highway safety programs and traffic laws in the Southeast by using DEA. From the results, we offer advice to the states with lower safety performance.

■ SA61

Mezzanine - 100B

Quality and Statistical Decision Making in Health Care Applications

Sponsor: Data Mining

Sponsored Session

Chair: Shuai Huang, Assistant Professor, University of South Florida, 4202 E Fowler Ave., ENC 2509, Tampa, FL, 33620, United States of America, shuai.huang.ie@gmail.com

1 - Using Propensity Scores to Evaluate an e-Health Technology for Depression Care

Haomiao Jin, University of Southern California, 3715 McClintock Ave., GER 240, Los Angeles, CA, 90089, United States of America, haomiaoj@usc.edu, Chih-Ping Chou, Pey-Jiuan Lee, Shinyi Wu, Irene Vidyanti, Kathleen Ell

Diabetes-Depression Care-management Adoption Technology (DCAT) is an innovative e-Health technology to facilitate evidence-based depression care in primary care settings for underserved populations. To evaluate DCAT, a three-arm quasi-experiment clinical trial involving 1400 low-income, predominantly minority diabetes patients was conducted. Propensity score method was applied to adjust for sampling bias in the outcome analyses. Results show that DCAT significantly improved depression care.

2 - Identifying Readmission-related Clinical Associations via a Novel Tree-embedded Graphical Model

Yazhuo Liu, University of South Florida, 14249 Les Palms Cir, Tampa, FL, 33613, United States of America, yazhuoliu@mail.usf.edu, Shuai Huang, Jose Luis Zayas-Castro, Peter Fabri

Failing to uncover clinical associations may hinder clinicians detecting important disease symptoms, which may lead to inadequate health care. Challenges of identifying those unknown clinical associations from the ICD-9 codes include the high-dimensionality of the ICD-9 codes and nonlinear interactions among them. We propose a novel tree-embedded graphical model to address these challenges.

3 - Cost-effective Enrichment Strategies for Alzheimer's Clinical Trial Screening by Data Mining

Mona Haghighi, University of South Florida, 12760, University Club Dr., Tampa, FL, 33612, United States of America, monahaghighi@mail.usf.edu, Shuai Huang

The development of anti-amyloid preventative treatments, which hold great promise of preventing Alzheimer's disease, rely on a cost-effective screening method for identifying amyloid positive subjects for clinical trials, which is currently lacking. We investigate how data mining approaches can help the development of cost-effective enrichment strategies.

4 - Challenges of Deploying an Open Access System for Outpatient Clinics via Process Mining

Ashkan Sharabiani, University of Illinois at Chicago, 842 W. Taylor Street, 4209 W SEL Building, Chicago, IL, United States of America, ashara2@uic.edu, Houshang Darabi

Recent advances in process mining (PM) have provided system analysts with a set of techniques for extracting fact-based patterns of system's processes from data. The presentation is about applying PM techniques in an outpatient clinic in an underrepresented district of Chicago to explore the possibility of deploying an open access system. After discovering the underlying processes, the open access system will be tested against the traditional pre-scheduled system using a simulation model

■ SA62

Mezzanine - 100C

Sensor-based Process Monitoring and Control

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 E. Fowler Ave., ENB118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Analyzing Nanoparticle Growth with Ex-situ Data

Chiwoo Park, Assistant Professor, Florida State University, 2525 Pottsdamer St., Tallahassee, FL, 32310-6046, United States of America, cpark5@fsu.edu

We present a nonparametric Bayesian model for analyzing the multi-modal growth of nanoparticles with ex-situ TEM image data in absence of in-situ observations. The model provides Bayesian estimation of multiple growth modes of nanoparticles. The estimation result was consistent with real nanoparticle growth trajectories in empirical studies.

2 - Greedy Bayesian Method for Sparse Vector Estimation with Performance Guarantee

Zhenyu (James) Kong, Associate Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, james.kong@okstate.edu, Kaveh Bastani, Wenzhen Huang

We propose a greedy Bayesian method for sparse vector estimation problems. The proposed algorithm benefits from the greedy approach of orthogonal matching pursuit (OMP) in determining the support set of sparse vector. Bayesian framework of the proposed method is adopted from relevance vector machine (RVM). Performance guarantee of the proposed method is obtained. We prove that the ideal risk of the proposed method outperforms the best known unbiased sparse estimator under certain conditions.

3 - Adaptive B-spline Knots Selection using Multi-resolution Basis Set

Nan Chen, Assistant Professor, National University of Singapore, 1 Engineering Drive 2, Singapore, 129789, Singapore, isecn@nus.edu.sg, Yuan Yuan, Shiyu Zhou

B-splines are commonly used in the Computer Aided Design (CAD) and signal processing to fit complicated functions. However, how to place the knots appropriately in B-spline curve fitting remains a difficult problem. In this paper, we proposed a two-stage knots placement method to place knots adapting to the curvature structures of the unknown function. We demonstrated the effectiveness using numerical studies on multiple representative functions.

4 - On-line Monitoring and Fault Diagnosis of Functional Imaging Profiles

Chen Kan, University of South Florida, 4202 East Fowler Ave. ENC 1205, Tampa, FL, 33620, United States of America, chenkan@mail.usf.edu, Hui Yang

Advancements in metrology have driven the statistical process control from monitoring individual data points to imaging profiles in manufacturing and biological processes. However, nonlinearity and nonstationarity pose significant challenges for process monitoring. This paper presents a two-phase greedy pursuit algorithm for the detection of transient events in imaging profiles. Further, we developed a novel dynamic network approach for online monitoring of functional imaging profiles.

■ SA63

Mezzanine - 100D

Data Fusion for Manufacturing Scale-up

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Ran Jin, Virginia Tech, Grado Dept of Industrial and Systems, Engineering, 111 Durham Hall, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

Co-Chair: Xinwei Deng, Assistant Professor, Virginia Polytechnic Institute and State University, Department of Statistics, 406 Hutcheson Hall, Blacksburg, VA, 24060, United States of America, xdeng@vt.edu

1 - A Bayesian Framework for Assessment of Prediction Uncertainty in Scale-up

Tirthankar Dasgupta, Harvard University, 1 Oxford St., Dept. of Statistics, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu

Reproducibility of experimental results under unknown, but perhaps predictable noise conditions is a challenge in scale-up operations. We propose a hierarchical Bayesian framework that allows augmentation of prior information about potential sources of variation in scale-up operations.

2 - QQ Model: Joint Modeling with Quantitative and Qualitative Responses in Manufacturing Scale-up

Xinwei Deng, Assistant Professor, Virginia Polytechnic Institute and State University, Department of Statistics, 406 Hutcheson Hall, Blacksburg, VA, 24060, United States of America, xdeng@vt.edu, Ran Jin

In manufacturing scale-up, both quantitative and qualitative responses are often used to measure the quality of products. In this work, we propose a novel method of jointly modeling quantitative and qualitative responses. The constraint likelihood approach is used to incorporate the inherent features of data and accommodate the association between two types of responses. The merits of the proposed method are illustrated by simulations and a real case study in semiconductor manufacturing.

3 - Data Fusion in Bio-Manufacturing and Soft Tissue Expansion Processes for Bio-Medical Applications

Xiaofeng Qin, North Carolina State University, Raleigh, NC, United States of America, xqin2@ncsu.edu, Yuan-Shin Lee

This paper presents the investigation of soft tissue expansion process for biomedical devices development and bio-manufacturing. The objective of the investigation is to describe the expansion as a manufacturing process with sufficient specifications, such that the process is reproducible within a given tolerance. This paper examines how collagen-based, soft tissue responds to mechanical deformation and the effects of different process parameters.

■ SA64

Mezzanine - 100E

Design for High Reliability, Robustness, and Resilience I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Zhimin Xi, Research Assistant Professor, University of Michigan, 4901 Evergreen Rd., Dearborn, MI, 48128, United States of America, zxi@umich.edu

1 - Optimal Multiple Stage Reliability Growth Test Plan Design for New Product Introduction

Zhaojun Li, Reliability Engineer, ElectroMotive Diesel, 211 W. 59th St., Apt. 3, Hinsdale, United States of America, zjli@uw.edu

This research reviews the major analytical activities for reliability growth test (RGT) planning during the new production introduction period. The impact of influential factors on the final achievable reliability for a new product is investigated using designed experiments. Testing cost for RGT is also analyzed in addition to achieving a better product reliability prediction.

2 - An Ensemble Approach for Model Bias Prediction

Zhimin Xi, Research Assistant Professor, University of Michigan, 4901 Evergreen Rd., Dearborn, MI, 48128, United States of America, zxi@umich.edu, Yan Fu, Ren-Jye Yang

This paper presents an ensemble approach for model bias prediction in order to correct predictions of computational models. The basic idea is to first characterize the model bias of computational models, then correct the model prediction by adding the characterized model bias. The ensemble approach is composed of two prediction mechanisms: 1) response surface of model bias, and 2) Copula modeling. Advantages of both mechanisms are utilized with an accuracy based weighting approach.

3 - System Reliability Optimization by using Monte Carlo Simulation and a Metaheuristic Algorithm

Krystel Castillo, Assistant Professor, The University of Texas at San Antonio, One Circle UTSA EB 3.04.54, San Antonio, TX, 78249, United States of America, krystel.castillovillar@utsa.edu, Harry Millwater, Ahmed Kibria, Eliseo Iglesias

This research addresses the challenge of allocating resources for inspection data acquisition for complex systems with multiple components and failure modes such as a military gas turbine engine. A nested loop approach using is proposed to determine the system's mean time to failure distribution and a metaheuristics was used to identify the optimal inspection data to be added at each subcomponent. This methodology can be applied to assess the economic impact of changing maintenance policies.

■ SA65

Mezzanine - 100F

Social Web Mining

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Zhepeng Li, Assistant Professor, York University, Schulich School of Business, Toronto, ON, Canada, Lionel.Li@business.utah.edu

1 - Peer Influence and Information Quality: The Case of Stock Micro-blogging

Chong Oh, Assistant Professor, Eastern Michigan University, 421 Owen Building, Ypsilanti, MI, 48197, United States of America, coh1@emich.edu, Olivia R. Liu Sheng

This study examines peer influence and Information Quality (IQ) in the context of individual investor characteristics in stock microblogging. We discovered that individual characteristics that relate to peer influence is not synonymous with IQ. Individuals with both high reputation and high engaging effort relate positively to peer influence but negatively to IQ. Those who are better at diffusing information via retweets are likely to associate with low IQ.

2 - Recommendation in Reciprocal and Bi-partite Social Networks — A Case Study of Online Dating

Xi Wang, The University of Iowa, 1000 W Benton E207, Iowa City, IA, 52242, United States of America, xi-wang-1@uiowa.edu, Kang Zhao, Mo Yu

Many real-world social networks, such as online dating and recruiting, are bipartite networks built on reciprocity. This study proposes a new collaborative filtering (CF) method for user recommendation in such social networks. It considers both the "taste" and "attractiveness" of users, so that users are interested in and attractive to recommended partners. An empirical study of online dating shows the new method performs better than other CF methods in recommending potential dating partners.

3 - Skills Recommendations in Online Labor Markets

Marios Kokkodis, PhD Student, New York University, Stern School of Business, New York, NY, United States of America, mkokkodi@stern.nyu.edu, Panagiotis Ipeirotis

In online labor markets employers make decisions based on workers' reputations and skillsets; in this work we focus on workers' skillsets. We assume that a stream of jobs that require a specific skillset has a utility that is a function of the volume of these jobs, their hiring probability and their average wage. By assuming that the market is in equilibrium we estimate the opportunity cost of learning a new skill and present an approach to strategically recommend the acquisition of new skills.

■ SA66

Mezzanine - 100G

Economic Behavior in the Lab and in the Field

Sponsor: Information Systems

Sponsored Session

Chair: Pallab Sanyal, Assistant Professor, George Mason University, 4400 University Dr, MS 5F4, Fairfax, VA, 22030, United States of America, psanyal@gmu.edu

1 - Transaction Utility and Culture

Kim Huat Goh, Assistant Professor, Nanyang Technological University, 50 Nanyang Avenue S3-B2A-34, Nanyang Business School, Nanyang Technol, Singapore, Si, 639798, Singapore, akhgoh@ntu.edu.sg, Sharon Ng

We examine the impacts of culture on consumers' transaction utility. We argue that Easterners have steeper transaction utility functions than Westerners. We found that the higher transaction utility experienced by Easterners is associated with higher arousal levels. We conducted studies to isolate the effects of higher transaction utilities; to measure higher levels of arousal in Easterners (scale and skin conductance measures); to refute alternative explanations and test boundary conditions.

2 - An Empirical Study of Reciprocity and Search Strategies in Online Barter Markets

Shun Ye, Assistant Professor, George Mason University, Enterprise Hall 138, 4400 University Drive, Fairfax, VA, 22030, United States of America, sye2@gmu.edu, Siva Viswanathan, Il-Horn Hann

This study examines users' search strategies and their impacts on transaction outcomes in online barter markets. We find that whereas users who adopt the immediate reciprocity strategy are able to motivate higher service quality for the current transaction, users who adopt the delayed reciprocity strategy derive more benefits for future transactions. We further find that market participants with different trading needs and psychographic profiles employ different search strategies in the market.

3 - Coordination by Sanctions: Internal and External Consequences in the Lab

Matthew Hashim, Assistant Professor, The University of Arizona, Tucson, AZ, United States of America, mhashim@email.arizona.edu

Contexts such as the piracy of information goods may lead to consequences for the individual (i.e., internal consequences such as litigation), and consequences for society (i.e., external consequences such as job loss). We conduct a lab experiment to study the role of these sanctions on coordination in a public goods game. Sanctions vary in type depending on treatment, having either internal consequences for individual free-riders, or external consequences imposed by free-riders on the group.

■ SA67

Mezzanine - 100H

Economics of Information and Learning

Sponsor: Decision Analysis

Sponsored Session

Chair: Wenxin Xu, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, wxu9@illinois.edu

Chair: Dharma Kwon, Assistant Professor, University of Illinois at Urbana-Champaign, Department of Business Administration, Champaign, IL, 61820, United States of America, dhkwon@illinois.edu

1 - Equilibrium Exploding Offers

John Mamer, Professor, University of California, Los Angeles, Anderson School of Management, Los Angeles, CA, 90064, United States of America, john.mamer@anderson.ucla.edu

A seller with a single unit for sale encounters a sequence of potential buyers. Each buyer offers a price and a duration over which the offer is valid: either indefinitely or only at the instant of the encounter (a so called exploding offer). This paper models the situation as a game with incomplete information and focuses on the buyers' equilibrium choice between exploding and non-exploding offers, taking the offers sizes as exogenous.

2 - On the Monotonicity of Value of Information with Risk Aversion in Two-Action Decision Problems

Zhengwei Sun, Post-doctoral Research Associate, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, zsun4@illinois.edu, Ali Abbas

This paper analyses the monotonicity of the value of information with risk aversion in two-action decision problems when the decision makers have uncertain initial wealth. We demonstrate that there is no general monotonicity between information value and the risk aversion function in this setting by two numeric examples. We then show that monotonicity exists with Rubinstein's measure or Ross's measure of risk aversion with some regulatory conditions.

3 - Impact of Bayesian Learning and Externality on Strategic Investment

Wenxin Xu, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, wxu9@illinois.edu, Anupam Agrawal, Suresh Muthulingam, Dharma Kwon

We consider a game of investment in uncertain projects. There exists postive and negative externality between the two firms' investments. We find that the interplay between externalities and Bayesian learning lead to counterintuitive results of firms' entry strategies.

4 - Managing Investment in Risky Prospects with Complementarities

Stefan Rampertshammer, Duke University, Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, stefan.rampertshammer@duke.edu, Sasa Pekec, R. Vijay Krishna

We examine a continuous time investment decision in multiple prospects of uncertain type. Good types produce a one-time payoff (success) after a random amount of investment while bad types never produce a payoff and we learn about these types through investment. Moreover, success in a prospect increases the reward to be obtained from future successes so an index policy need not be optimal. We show that the optimal policy is a threshold policy and exhibits two distinct patterns of investment.

■ SA68

Mezzanine - 100I

Decision Behavior Following Low Probability Events and Near Misses

Sponsor: Decision Analysis

Sponsored Session

Chair: Matthias Seifert, Assistant Professor of Quantitative Methods, IE Business School, Maria de Molina 12, 5∞, Madrid, 28006, Spain, Matthias.Seifert@ie.edu

1 - The Influence Disaster Severity and Outcome Attribution on Travel Behavior

Heather Rosoff, Research Assistant Professor, University of Southern California, CREATE, RTH-315, MC-2902, Los Angeles, CA, 90089-2902, United States of America, rosoff@usc.edu, Richard John

The decision to travel by plane following a disaster event depends on the individuals' decision making under uncertainty. We examine how air travel decision making is influenced by the severity of the event and attribution of the outcome.

2 - The Effect of Near Miss Events on Intertemporal Choice Behavior

Florian Federspiel, PhD Candidate, IE Business School, Maria de Molina 12, Bajo, Madrid, 28006, Spain, ffederspiel.phd2014@student.ie.edu, Matthias Seifert

We study the impact of "near misses" (i.e. events that almost lead to disastrous outcomes and are only averted due to chance circumstances) on intertemporal choice behavior. Using an experimental research design motivated by Andreoni and Sprenger (2012), we systematically test how individuals' preference for risk after experiencing such near miss events may lead to violations of the assumptions underlying discounted expected utility (DEU).

3 - Product Counterfeiting - A Buying Personnel Behavioral Model

Jillian Watson, PhD Candidate, Clemson University, 100 Sirrine Hall, Clemson, SC, 29634, United States of America, jilliad@clemson.edu, Aleda Roth

This research presents the development of a behavioral experiment to examine how buying personnel incentives and other factors interact to influence the buyer's likeliness to accept a situation where product counterfeit risk is high.

■ SA69

Mezzanine - 100J

Reliability and Real Options in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Victor Richmond Jose, Georgetown University, McDonough School of Business, Washington, DC, United States of America, vrj2@georgetown.edu

1 - Understanding Behaviors of Owners of Interdependent Infrastructure Systems to Improve Reliability

Allison Reilly, Post-doctoral Research Fellow, Johns Hopkins University, 3400 N. Charles Street, Ames Hall, Baltimore, MD, 21218, United States of America, allison.reilly@gmail.com, Seth Guikema, Andrew Samuel

Increasing emphasis on interdependent infrastructure networks has provided a better understanding of their physical vulnerabilities. However, there has been little discussion on the behavior of infrastructure owners and how their decisions affect dependent systems' reliability. In this work, we develop a game-theoretic model to explore how owners make investment decisions and how to provide third-party incentives to improve overall network reliability.

2 - Reliability Estimation for Systems Subject to Degradation and Impact Loading

Sara Ghorbani, PhD Student, Rutgers University, 4340 BPO Way, Piscataway, NJ, 08854, United States of America, ghorbani@rci.rutgers.edu, Hoang Pham, Elsayed A. Elsayed

We present a model for predicting the reliability of systems subject to degradation and impact loading considering the effect of system's age on damage due to impact. We then extend this model by considering the correlation between the degradation and impacts. The system reliability expressions of the proposed models are presented which are then validated through simulation modeling.

3 - Real Options Analysis in Municipal Solid Waste Treatment Projects

Luiz Ozorio, Associate Professor, Ibmec Business School, Av. Presidente Wilson,118/1114, Rio de Janeiro, Brazil, lmozorio@ibmecrj.br, Carlos Bastian-Pinto, Jorge Luiz Assalie, Luiz Eduardo Brandao

The adequate destination of municipal solid waste (MSW) is one of the biggest challenges of the humanity. Besides the environmental benefits, the MSW treatment projects can produce biogas to produce energy. Another issue that must be considered is that the increase in the processing capacity can be done in steps, creating the flexibility of delaying the project investments. This work indentifies the flexibilities in MSW projects in order to value their impact on NPV using real options analysis.

4 - Bayesian Learning Real Options with Application to Aerospace Licenses

Luke Miller, Professor, Saint Anselm College, 100 Saint Anselm Drive, Manchester, NH, 03102, United States of America, lukemiller@anselm.edu

We investigate the feasibility of applying options pricing and Bayesian decision theory to value aerospace strategic licensing opportunities in the parts manufacturing approval (PMA) industry. With a PMA industry valued at over $55 billion and encompassing over 245,000 parts across 2,000 PMA license holders, our main contribution was identifying that each license could be framed as a financial option and valued accordingly.

■ SA70

Mezzanine -101A

OR Dev from Sabre

Sponsor: Aviation Applications

Sponsored Session

Chair: Xiaodong Luo, Pincipal, Operation Research Development, Sabre Holding, Inc, 8400 Halliford Court, Plano, TX, 75024, United States of America, Xiaodong.Luo@sabre.com

1 - Experiments with Follow-on Fixings to Solve Large MIPs

Yogesh Dashora, Senior Operations Research, PhD, Sabre Holdings Inc. (Sabre Travel Tech. Pvt. ltd. in India), Navigator Level II, ITPL, Whitefield Rd., Bangalore, 560066, India, yogesh.dashora@sabre.com

The Crew Pairing Optimization problems which use well established set partitioning framework are known to be large scale MIPs, which are very difficult to solve. One of the many strategies employed to solve them is follow-on fixing in the column generation context. We talk about our experiments with and enhanced Crew Pairing Optimization model and using a relaxed follow-on fixing strategy. We identify benefits and limitations of using such strategy from practical perspective.

2 - Gate Assignment Problem with Swing Gates

Yidong Zhang, Sabre Airline Solutions, 1055 West Zhongshan Road, Room 1008, Shanghai, China, yidong.zhang@sabre.com

Traditional models for a gate assignment problem (GAP) assign arrival/departure flights to gates on schedule, where gates are configured to serve either domestic or international flights. For airports to fully utilize limited resources, some gates (swing gates) could serve different types of flights. Here we present a model not just assigning flights to gates, but also determining the time when a gate swings to serve other types of flights. Numerical experiments validated the design of model.

3 - Speeding up Volume Algorithm

Xiaodong Luo, Principal, Sabre Holdings, Inc, 8400 Halliford Court, Plano, TX, United States of America, Xdluo@yahoo.com, Dong Liang

Volume algorithm (Barahona and Anbil 2000, 2002) has shown success for large problems such as crew scheduling, uncapacitated facility locations. We compare this approach with a well- studied non-linear optimization technique - Method of Multipliers, and show: they share the same primal and dual search directions and only differ on the conditions for accepting a dual iterate. We show how to accelerate the algorithm for solving large Crew Scheduling as well as Airline Revenue Management problems.

4 - PNR Show-up Forecasting

Bill Pun, Senior Operations Research Consultant, Sabre Holdings, 3601 Grapevine Mills Pkwy, Grapevine, TX, 76951, United States of America, Bill.Pun@sabre.com

Accurate show-up probabilities are critical in determining appropriate overbooking levels. Traditionally, show-up probabilities are forecasted at the flight-cabin level. With abundant PNR data nowadays, show-up probabilities can be forecasted at the PNR level using passenger, trip, and segment information. Multiple regression models are evaluated. Comparing with our current method, the best model improves the forecast accuracy by as much as 25%.

■ SA71

Mezzanine -101B

Emerging Aviation Applications

Sponsor: Aviation Applications

Sponsored Session

Chair: Praowpan Tansitpong, Assistant Professor, State University of New York at New Paltz, VH303 1 Hawk Drive, New Paltz, NY, 12561, United States of America, tansitpp@newpaltz.edu

1 - Stochastic Integer Programming Models for Air Traffic Flow Management

Saravanan Venkatachalam, PhD Candidate, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX, United States of America, saravanan@entc.tamu.edu, Guglielmo Lulli, Luca Corolli, Lewis Ntaimo

We present a two-stage stochastic integer programming formulation for the air traffic flow management (ATFM) problem under capacity uncertainty due to variable weather conditions. The model deals with the strategic problem of resolving imbalances between air traffic system demand and capacities through the definition of flight control actions. We consider a decomposition approach that takes advantage of the underlying structure of the problem to solve realistic instances of the problem.

2 - Optimal Serving Schedules for Multiple Queues with Size-independent Service Times

Yuhang Liu, Graduate Student, University of Minnesota, 1849 Washington Ave. S Apt112, Minneapolis, MN, 55454, United States of America, liuxx839@umn.edu, Zizhuo Wang

We consider a service system with two Poisson arrival queues. A server chooses which queue to serve at each moment. Once a queue is served, all the customers are served within a fixed time. This model is useful in studying airport shuttling or certain online computing systems. We first establish an MDP for this problem and study its structures. We then propose a simple yet optimal state independent policy for this problem which is not only easy to implement, but also performs very well.

3 - Airline Product Variation: The Interplay between Perceived Quality and Resource Utilization

Praowpan Tansitpong, Assistant Professor, State University of New York at New Paltz, VH303 1 Hawk Drive, New Paltz, NY, 12561, United States of America, tansitpp@newpaltz.edu

This paper explores how operational decisions regarding a quality-differentiated product line determines the overall success of a multiproduct firm in the marketplace. Airlines provide multiple quality products with large variation at difference prices for the first, business, and economy class. We empirically investigate the impact of number of airline products under market constraints, given limited capacity and resources.

■ SA72

Mezzanine -101C

Topics in OR/MS

Contributed Session

Chair: Wei Chen, University of Pittsburgh, 241 Mervis Hall, University of Pittsburgh, Pittsburgh, PA, 15260, United States of America, wchen@katz.pitt.edu

1 - Empirical Modeling of In-kind Donations for a Non-profit Hunger Relief Organization

Lauren Davis, Associate Professor, North Carolina A&T State University, 1601 E. Market Street, Greensboro, NC, 27411, United States of America, lbdavis@ncat.edu, Steve Jiang

Non-profit organizations that respond to humanitarian emergencies rely on the goodwill of donors to help them achieve their objectives. Resources provided by donors represent uncertain sources of supply that enable delivery of goods or services. Using data from a non-profit hunger relief organization, we characterize the nature of supply uncertainty and present several predictive models to estimate the quantity of donated supply.

2 - Problem-Solving Steps in Management Sciences

Toshikazu Aiyama, Professor, Tokyo Metropolitan University, 1-1 Minami Ohsawa, Hachiohji, 192-0397, Japan, tyaiyama@yahoo.com

A basic framework for problem solving steps is explored emphasizing on problem identification and implementation. We have found that these two steps are almost ignored in the past, and that only problem solution step is largely researched in OR/MS. We will examine these two steps to find some issues involved there. Finally we will propose preliminary substeps in these two steps.

3 - Generalizability Approach for Multisource Feedback

Yeonjeong Kim, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA 15213, United States of America, yeonjeongkim@cmu.edu, Taya Cohen, Jae-Chang Jeong, Sehee Hong

Multisource feedback provides rich information from diverse viewpoints; however, errors can result from each of the multiple evaluators and interactions between the evaluators and evaluation domain. This paper uses 360-degree leadership data to demonstrate how researchers can use Generalizability theory (G-theory) to disentangle multiple sources of error. G-theory enables researchers to determine the optimal number of evaluators and items for obtaining reliable information about the target.

4 - Conducting Social Responsibility through a Supply Chain

Wei Chen, University of Pittsburgh, 241 Mervis Hall, University of Pittsburgh, Pittsburgh, PA, 15260, United States of America, wchen@katz.pitt.edu, Jennifer Shang

Corporate Social Responsibility (CSR) has been widely adopted by most organizations; however whether organizations can successfully jointly perform CSR activities is less discussed. In this paper, we investigate that how to conduct CSR throughout entire a supply chain, and offer managerial insights to encourage more organizations to participate in CSR activities.

Sunday, 11:00am - 12:30pm

■ SB01

Level 2 - Room 200A

Modeling Systemic Risk II

Cluster: Optimization in Finance

Invited Session

Chair: David Brown, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, dbbrown@duke.edu

Co-Chair: Ciamac Moallemi, Associate Professor, Columbia University, 3022 Broadway Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

1 - Inefficient Diversification

Kostas Bimpikis, Stanford University, Stanford, CA, United States of America, kostasb@stanford.edu, Alireza Tahbaz-Salehi

We argue that in the presence of liquidation costs, portfolio diversification may be socially inefficient. In our model, banks have an incentive to hold diversified portfolios. Yet, diversification may increase the aggregate risk for the depositors creating a negative externality. Systemic risk increases since even though diversification decreases the probability of each bank's failure, it may increase the probability of joint failures, which may be inefficient for risk-averse depositors.

2 - Systemic Risk Insurance-reinsurance Networks

Jose Blanchet, Professor, Columbia University, 500W 120th Street, New York, NY, United States of America, jose.blanchet@columbia.edu, Yixi Shi

We discuss systemic insurance and reinsurance risk networks. We obtain equilibrium settlements via the solution of a linear program, and impose a probabilistic structure that allows to compute the most likely path to a systemic breakdown via the solution of a combinatorial optimization problem. We study questions such as: Which group of companies are the most relevant from a systemic risk standpoint?, and how to quantify the role of reinsurance companies in systemic risk?

3 - Optimal Capital Requirements in Interbank Networks

Jongsoo Hong, Duke University Fuqua School of Business, 1 Fuqua Drive Fuqua School of Business, Durham, United States of America, jongsoo.hong@duke.edu, David Brown

We consider a network of banks, with connections representing interbank liabilities, and study the problem of optimally trading off between capital reserves and systemic risk. In a model without default costs, the problem may be formulated as a stochastic linear program. Default costs make the problem much more challenging, and we discuss approximation methods. We demonstrate the methods on an example using data from a central bank.

■ SB02

Level 2 - Room 200B

Database Structure Design of Stochastic Optimization Based DSS

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Goutam Dutta, Professor, Indian Institute of Management, Wing 3,PMQ Area , Room No 3H, Ahmedabad, 380015, India, goutam@iimahd.ernet.in

1 - Database Structure for a Stochastic Optimization Based DSS for ALM in Life Insurance Firms

Harish Rao, Doctoral Student, Indian Institute of Management, Ahmedabad, India, harishrao@iimahd.ernet.in, Goutam Dutta

In this paper, we introduce a stochastic optimization based DSS for the strategic planning needs (asset-liability management) of a life insurance firm using a multi-period stochastic optimization model. We discuss the issues related to database structure, DSS interface design, SLP development, database updation and solution reporting.

2 - Extensions to AMPL for Optimisation under Uncertainty

Gautam Mitra, President, Optirisk System, London, United Kingdom, gautam@optirisk-systems.com, Christian Valente, Victor Zverovich

We describe a set of extensions to AMPL for representing robust optimisation problems and various classes of stochastic programming problems. We describe syntax and semantics of the extensions and discuss solver requirements, reformulation techniques and connection between the modelling system and external solvers. In particular, we show that direct representation of some of the modelling constructs makes the models easier to understand and facilitates the use of specialised solution algorithms.

■ SB03

Level 2 - Room 200C

Theory of Mixed-Integer Nonlinear Optimization

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Alberto Del Pia, PostDoc researcher, ETH Zurich, ETH Zurich - HG G 21.3, Rämistrasse 101, Zurich, 8092, Switzerland, alberto.delpia@gmail.com

1 - Convex Integer Minimization in Variable Dimension

David Adjiashvili, Dr., ETH Zurich, ETH HG, Raemistrasse 101, Zurich, 8092, Switzerland, david.adjiashvili@ifor.math.ethz.ch

We study a convex integer minimization problem in variable dimension. Given an integer matrix W with n columns and d rows, a convex function f over R^d and a polyhedron P in R^n, we would like to minimize f(Wx) subject to x in P, integer. Assuming d to be fixed, and W to be given in unary representation, we study classes of polyhedra P, for which the latter problem can be solved in polynomial time.

2 - Exploiting Separability in Outer-Approximation Methods

Hassan Hijazi, National ICT Australia, 7 London Cct, Canberra, 2601, Australia, Hassan.Hijazi@nicta.com.au

A common structure in convex mixed-integer nonlinear programs (MINLPs) is separable nonlinear functions. In the presence of such structures, we propose a number of improvements to the outer approximation algorithms. As a side result, we exhibit a simple MINLP model where a classical implementation of the outer approximation would take an exponential number of iterations, whereas the new formulation would converge linearly.

3 - On the Computational Complexity of Quadratic Integer Programming

Diego Alejandro Moran Ramirez, Georgia Institute of Technology, 225 North Ave. NW, Atlanta, GA, 30332, United States of America, dmoran@gatech.edu, Vishnu Narayanan, Santanu Dey

A Convex Quadratic Integer Program (CQIP) is the optimization problem of minimizing a linear function subject to m convex quadratic constraints, where all the data is defined by rational numbers. In this talk, we show (under some sufficient conditions) that if (CQIP) has an optimal solution, then there exists an optimal solution of size bounded by a polynomial in the size of the data defining the problem, when the number of constraints is fixed.

■ SB04

Level 2 - Room 200D

Advances in Theory and Computation of Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Kiavash Kianfar, Associate Professor, Texas A&M University, TAMU 3131, College Station, TX, 77840, United States of America, kianfar@iemail.tamu.edu

1 - Sufficiency of Cut-generating Functions

Sercan Yildiz, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, syildiz@andrew.cmu.edu, Gerard Cornuejols, Laurence Wolsey

Cut-generating functions have their origin in the work of Gomory and Johnson from the 1970's and have received renewed attention in recent years. We settle an open problem and show that cut-generating functions are able to generate all possible cuts with a positive right-hand side under a technical sufficient condition.

2 - Generalizations of Continuous Mixing Set: Extended Formulations and Facets

Manish Bansal, PhD Student, Texas A&M University, TAMU 3131, College Station, TX, 77843, United States of America, bansal@tamu.edu, Kiavash Kianfar

We introduce and study some important generalizations of the well-studied continuous mixing set. We develop extended formulations and facet-defining cutting planes for these sets. We also present an exact separation algorithm for the developed cuts. Our computational results show that our cuts are very effective for the multi-module lot-sizing problems with(out) backlogging, resulting in considerable reduction in the integrality gap, the number of nodes, and solution time.

3 - Submodular Path Inequalities for the Capacitated Fixed-Charge Network Problem

Birce Tezel, University of California, Berkeley, Sutardja Dai Hall (CITRIS) Room: 450, Berkeley, CA, 94720, United States of America, btezel@berkeley.edu, Alper Atamturk, Simge Küçükyavuz

In this study, we derive new valid inequalities for path substructures of the capacitated fixed-charge network problem. These strong valid inequalities are based on the exact characterizations of submodular inequalities and they generalize the well-known flow cover and path inequalities. We present computational results showing the effectiveness of the inequalities when used as cuts in a branch-and-cut framework.

■ SB05

Level 2 - Room 200E

Game Theory and Discrete Optimization Applications in Matching Markets, Scheduling, E-commerce

Sponsor: Optimization/Networks

Sponsored Session

Chair: Shyam Sundar Chandramouli, PhD Student, Columbia University, 547 riverside Dr, Apt. 2E, NYC, NY, 10027, United States of America, sc3102@columbia.edu

1 - Optimal Truncation in Matching Markets

Ran Shorrer, PhD Student, Harvard University, 11 Peabody Terrace, Apt. 510, Cambridge, Ma, 02138, United States of America, rshorrer@hbs.edu, Peter Coles

Recent studies have presented conditions under which truthful reporting by all participants in a two-sided matching market is close to optimal. Our results demonstrate that in large uniform markets with incomplete information, using the Men-Proposing Deferred Acceptance Algorithm, each woman's best response to truthful behavior by all other agents is to truncate her list substantially. In fact, the optimal degree of truncation goes to 100% of her list as the market size grows large.

2 - Fair Allocation on Economic Networks

Shyam Sundar Chandramouli, PhD Student, Columbia University, 547 Riverside Dr., Apt. 2E, New York, NY, 10027, United States of America, sc3102@columbia.edu

This talk is related to a unified approach to fair allocation on bipartite economic networks. We study the group strategyproof and strong invariance property of Egalitarian and Edge Fair mechanisms. We also analyze the "price of consistency" i.e. how consistent mechanisms fail to be incompatible with certain notions of fairness. We conclude with mechanisms of fair allocation to more general non-bipartite networks.

3 - Efficient, Fair, and Group Strategy-proof (Re)Allocation under Network Constraints

Karol Szwagrzak, Graduate Student, University of Rochester, 280 Hutchison Road, Box 270156, Rochester, NY, 14627, United States of America, karol.s.flores@gmail.com

We examine the strategy-proof (re)allocation of commodities among a group of agents in a network. Agent can receive an amount of a commodity only if the network contains an arc connecting her to it. The relevant fairness notion in reallocation problems is "fair net trades" [Schmeidler, D. and K. Vind. 1972. Fair net trades. Econometrica, 40, 637-642]. When a single commodity is to be reallocated, we identify the only strategy-proof Pareto-efficient allocation rule satisfying fair net trades.

4 - Bandits with Knapsacks

Ashwinkumar Badanidiyuru, Phd Student, Cornell University, 312 Thurston Ave., A34, Ithaca, NY, 14850, United States of America, ashwinkumarbv@gmail.com, Aleksandrs Slivkins, Robert Kleinberg

We introduce a model for Multi-armed bandit problems with supply limits, called "bandits with knapsacks"that combines aspects of stochastic integer programming with online learning. We present two learning algorithms whose reward is close to the information-theoretic optimum. Further, we illustrate the generality of the problem by presenting applications in a number of different domains including routing, scheduling and electronic commerce.

■ SB06

Level 2 - Room 200F

Recent Theoretical and Computational Developments in Interior-point Methods

Sponsor: Optimization/Linear Programming and Complementarity

Sponsored Session

Chair: Murat Mut, Doctorate Student, Lehigh University, 200 W. Packer Ave., Bethlehem, PA, 18015, United States of America, mhm309@lehigh.edu

1 - A Tight Iteration-complexity Bound for IPM via Redundant Klee-Minty Cubes

Murat Mut, Doctorate Student, Lehigh University, 200 W. Packer Ave., Bethlehem, PA, 18015, United States of America, mhm309@lehigh.edu, Tamas Terlaky

We consider two curvature integrals for the central path of a polyhedra. Redundant Klee-Minty cubes (Nematollahi et al., 2007) have central path whose geometric curvature is exponential in the dimension of the cube. We prove an analogous result for the curvature integral introduced by Sonnevend et al. 1990. Within an algorithmic framework, we rigorously prove that the iteration-complexity upper bound for the Klee-Minty cubes is tight.

2 - High-performance Implementation of Positive Matrix Completion for SDPs

Makoto Yamashita, Associate Professor, Tokyo Institute of Technology, 2-12-1-W8-29, Ookayama, Meguro-ku, Tokyo, Japan, Makoto.Yamashita@is.titech.ac.jp, Kazuhide Nakata

When SDPs (SemiDefinite Programs) have structural sparsity, the positive matrix completion method can exploit the sparsity and reduce the computation time. Nakata et al. implemented SDPA-C by embedding the completion method into the interior-point method. We replace the SDPA-C bottleneck with a more efficient formula due to the property of the inverse of variable matrix. Furthermore, with the enhancement of multiple-threading, the new SDPA-C successfully solves SDPs in a shorter time.

3 - The Sonnevend Curvature and the Klee-walkup Result

Murat Mut, Doctorate Student, Lehigh University, 200 W. Packer Ave., Bethlehem, PA, 18015, United States of America, mhm309@lehigh.edu, Tamas Terlaky

We consider Sonnevend's (1991) curvature for the central path (CP) of LO problems. Our main result is that to get an upper bound for the total Sonnevend curvature of CP, it is enough to consider the case n=2m. This also implies that worst cases for path-following IPMs occur too when n=2m, and also yields an asymptotic O(n) lower bound for Sonnevend's curvature. We were motivated by the work of Deza et al. (2008), who gave analogous results of the Klee-Walkup result for the geometric curvature.

■ SB07

Level 2 - Room 200G

Stochastic/Robust Optimization on Energy Applications

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Muhong Zhang, Assistant Professor, Arizona State Unviersity, 699 S Mill Ave., Tempe, AZ, 85281, United States of America, Muhong.Zhang@asu.edu

1 - Stochastic Day-ahead Unit Commitment with Dynamic Reserves Policies

Garret LaBove, Research Assistant, Arizona State University, PO Box 875706, GWC 206 School of ECEE ASU, Tempe, AZ, 85287-5706, United States of America, garret@asu.edu, Kory Hedman

Decomposition techniques are routinely investigated to reduce the computational complexities associated with stochastic optimization. However, specific properties of power system operations management and scheduling introduce challenges that are not readily overcome by general solution techniques. This talk will demonstrate that dynamic reserve requirement policies can aid in addressing supply-side uncertainty of renewable generation assets in decomposed, stochastic day-ahead unit commitment.

2 - Transmission Switching for Improving Wind Power Utilization
Jianhui Wang, Affiliate Professor, Auburn University, 9700 S. Cass Avenue, Bldg. 221, Argonne, IL 60439, USA, Argonne, IL, 60439, United States of America, jianhui.wang@anl.gov, Feng Qiu

This study explores the possibility of using transmission switching, to change transmission network topology,for accommodating higher utilization of wind power. The uncertainty in wind power is modeled by scenarios, and the transmission switching problem is formulated as a two-stage stochastic integer program, minimizing thermal generator costs while maintaining a specified utilization level for wind power.

3 - A Tolling Approach for Optimal Control of Plug-in Hybrid Electric Vehicles
Jing Ma, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, majing@ufl.edu

We first model a PHEV owner's optimal charging / discharging patterns as a shortest path problem and propose an algorithm to minimize the total cost for its daily activities. For a group of PHEVs which have impact on the real-time LMPs, we introduce a tolling mechanism to adjust the system's flows to optimal. Our tolling can improve the system performance by reducing congestion and abrupt demand patterns to the grid. The computational tests show encouraging results for the proposed approach.

4 - Data-driven Robust Unit Commitment
Gregory Thompson, Arizona State University, 699 S Mill Ave., Tempe, AZ, 85281, United States of America, glthomp5@asu.edu, Muhong Zhang

Unit commitment is one of the most critical tasks to determine the generator schedules in power grid operations. Robust unit commitment models align with the high reliability standards in the power industry. This talk focuses on the whole process from modeling the historical data as uncertainty sets jointly with the robust models to determine reliable solutions. Numerical experiments show the computational efforts and solution reliability with alternative approaches to model the uncertainties.

■ SB08

Level 2 - Room 200H

Progressive Hedging for Non-linear and Mixed Integer Problems

Sponsor: Computing Society

Sponsored Session

Chair: David Woodruff, University of California-Davis, Graduate School of Management, Davis, CA, 95616, United States of America, DLWoodruff@UCDavis.edu

1 - Progressive Hedging Applied to Mixed-Integer and Non-Linear Stochastic Programs
David Woodruff, University of California-Davis, Graduate School of Management, Davis, CA, 95616, United States of America, DLWoodruff@UCDavis.edu

In this introduction, we provide a tutorial overview of Progressive Hedging (PH) from a computational perspective with an eye toward applications to mixed integer (MIP) and non-linear (NL) problems, including a brief survey of literature concerning applications. We also survey literature concerning algorithmic and tuning innovations to support the effective solution of MIP and NL using PH. We also describe the PySP open-source software that supports continuing research at many locations.

2 - Nonlinear Parameter Estimation in Parallel using Progressive Hedging
Carl Laird, Professor, Texas A&M University, 3122 TAMU, College Station, TX, 77843, United States of America, Carl.Laird@tamu.edu, Daniel Word, Jean-Paul Watson, David Woodruff

Nonlinear programming has proven an effective tool for tackling many real-world problems. However, as problem size continues to grow, solution approaches utilizing parallel computing are necessary. Noting the equivalency between parameter estimation problems and stochastic nonlinear programming, here we use a parallel progressive hedging algorithm to efficiently estimate parameters in a large-scale nonlinear infectious disease model using the PySP stochastic programming package from Pyomo.

3 - A Greedy Algorithm for Two-stage Stochastic Programs with Decision-dependent Probabilities
Hugh Medal, Assistant Professor, Mississippi State University, 260 McCain Engineering Building, Mississippi State University, MS, 39762, United States of America, hugh.medal@msstate.edu

We study a two-stage stochastic program with a maximization objective and decision-dependent probabilities, i.e., the probability distribution is a function of the first-stage decisions. We show that for several discrete distributions, the objective function is directionally concave if the recourse function is submodular in the righthand side. This property implies that a continuous greedy algorithm with sampling has a worst-case guarantee of 0.63 times the optimal objective value.

4 - Scenario Clustering in a Progressive Hedging-based Meta-heuristic for Stochastic Network Design
Teodor Gabriel Crainic, Professor, School of Management & CIRRELT, Universite du Quebec a Montreal, Montreal, PW, Canada, TeodorGabriel.Crainic@cirrelt.ca, Mike Hewitt, Walter Rei

Progressive hedging offers a framework for developing best-in-breed meta-heuristics for solving scenario-based integer programs. Traditional implementations repeatedly solve single-scenario subproblems. We seek to understand whether higher quality solutions can be found in less time by solving subproblems that are comprised of multiple scenarios. We develop systematic strategies for choosing subproblems and evaluate them with an extensive computational study.

■ SB09

Level 2 - Room 200I

Business Analytics in the Big Data Era

Sponsor: Analytics Section

Sponsored Session

Chair: Hui Xiong, Associate Professor, Rutgers University, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, hxiong@rutgers.edu

1 - Big Data Analytics in Mobile Environments
Hui Xiong, Associate Professor, Rutgers University, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, hxiong@rutgers.edu

Advances in sensor, wireless communication, and information have enabled us to collect and process "big mobile data" from multiple sources and time. In this talk, I discuss some emerging big data applications and the main technical challenges of big data analytics in mobile environments. In particularly, it is extremely important to investigate how the underlying computational models can be adapted for managing the uncertainties in relation to big data process in a huge nebulous environment.

2 - Understanding Social Dynamics – A Computational Approach
Jaideep Srivastava, Professor, University of Minnesota, Minneapolis, MN, United States of America, srivasta@cs.umn.edu

First, we describe findings from the Virtual World Exploratorium; a multi-institutional, multi-disciplinary project which considers data from commercial MMOGs and VWs for social science. Second, we provide a survey of new approaches for behavioral informatics that are being developed by multi-disciplinary teams, and their successes. Third, we discuss some novel potential applications and their associated research issues. Finally, we present commercial applications of Social Analytics research.

3 - Multi-source Information Fusion for Residential Real Estate Ranking
Keli Xiao, Stony Brook University, Stony Brook, NY, United States of America, keli.xiao@gmail.com

Given the risk factors and volatility inherent in the real estate business, it is critical to provide rating capabilities for residential real estate. In this paper, we provide a residential real estate ranking system based on multi-source information fusion. Specially, in addition to traditional features, we aim at extracting the features from urban geography data, such as Point of Interests, as well as the features from human mobility patterns.

4 - Behavior-driven Social Network Mining and Analysis for Business Intelligence
Feida Zhu, Singapore Management University, 80 Stamford Road, Singapore, Singapore, fdzhu@smu.edu.sg

A distinct feature characterizing social network data is the rich user behavior information. These interactive behavior information could collectively reveal tremendous insight into a wide range of social network patterns. In this talk, we discuss how longitudinal behavior data collected over a time span can be leveraged to facilitate a number of interesting social network mining and analysis tasks.

■ SB10

Level 2 - Room 200J

Case Competition I

Sponsor: INFORM-ED

Sponsored Session

Chair: Palaniappa Krishnan, Associate Professor, University of Delaware, 531 S.College ave., Newark, DE, 19716, United States of America, baba@udel.edu

1 - Case Competition

Palaniappa Krishnan, Associate Professor, University of Delaware, 531 S.College ave., Newark, DE, 19716, United States of America, baba@udel.edu

INFORMed's Annual Case Competition is an Opportunity for INFORMS Members to Showcase Their Efforts in the Classroom. Cases are Often Later Published.

■ SB11

Level 2 - Room 201A

Queuing Models

Sponsor: Telecommunications

Sponsored Session

Chair: Jeffrey Kharoufeh, Associate Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, jkharouf@pitt.edu

1 - Resource Management in Data Centers with Non-Homogeneous and Multi-class Workload

Soongeol Kwon, Texas A&M University, 3021 ETB, 3131 TAMU, College Station, 77843, United States of America, soongeol@tamu.edu, Natarajan Gautam

We consider resource management in data centers where multiple classes of requests arrive at a dispatcher at time-varying rates. This paper develops strategies to: (i) assign classes to servers, (ii) determine when each of servers would be powered on and off, (iii) set the processing speed of each server and (iv) route requests from dispatcher to servers. The objective is to achieve time-stable performance while maintaining high performance and cost-effectiveness with time-varying arrivals.

2 - Optimal Routing in a Channel with Failure-prone Links

David Abdul-Malak, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, United States of America, dta10@pitt.edu, Jeffrey Kharoufeh

We study optimal dynamic link selection in a hybrid channel with two diverse links. Specifically, the faster link is failure-prone while the slower link is not. The objective is to minimize the long-run average number of jobs in the system. We show that it is always optimal to use the faster link when it is available, irrespective of its failure and repair rates. For the slower link, we prove the optimality of a threshold policy that depends on the queue length and the state of the faster link.

3 - A Many-server FWLLN for Queueing Networks with Time-varying Parameters and Markovian Routing

Ahmet Korhan Aras, Ph.D. student, North Carolina State University, 2152 Burlington Labs, 2500 Stinson Drive, Raleigh, NC, 27695, United States of America, akaras@ncsu.edu, Yunan Liu

A many-server heavy-traffic FWLLN is established for the (G_t/GI/s_t+GI)^m/M_t queueing network allowing customer abandonment, general service times, time-varying arrival rates, time-varying staffing levels, and customer feedbacks (after service completions) in a Markovian fashion. This limit theorem, extending the FWLLN for single queues, provides a rigorous mathematical justification and solid theoretical basis for a previously proposed deterministic network fluid approximation.

■ SB12

Level 2 - Room 201B

Organizational Theory and Organizational Change

Sponsor: Organization Science

Sponsored Session

Chair: Emily Block, University of Notre Dame, Mendoza College of Business, Notre Dame, IN, United States of America, eblock1@nd.edu

1 - Hazards of Riding the Wave: Predictable Failure from Inverted Aspiration Divergence

David Souder, University of Connecticut, 2100 Hillside Road, Unit 1041, Storrs, CT, 06269, United States of America, DSouder@business.uconn.edu, Scott Johnson

The aspirations of external stakeholders normally impose constraints on managers, but if external stakeholders temporarily have higher aspirations than managers then managers may be inclined to exploit the situation. Using data from IPOs of Internet-related companies before and during the 1999-2000 'bubble,' we find empirical support for the counterintuitive hypothesis that firms exploiting temporary access to resources may hasten a firm's demise instead of prolonging its success.

2 - Conformity and Decoupling in the Face of Pluralism: Theoretical Lessons Inspired by Stories of Compliance and Defiance of the Church in the Rwandan Genocide

Emily Block, University of Notre Dame, Mendoza College of Business, Notre Dame, IN, United States of America, eblock1@nd.edu

A key challenge for institutional theory has been the systematic understanding of conformity and deviance. This quest has been further complicated by recent work calling for a more comprehensive picture of the complexity that comes with pluralistic institutional environments. In this research we consider the conditions under which actors in a pluralistic institutional environment will join the majority and conform to institutionally driven behaviors and the conditions under which actors are likely to deviate and defy institutionally prescribed behavior. In order to illustrate this theorizing we draw from stories that emerge from the study of the 1994 Rwandan Genocide and in particular the role of the Church during that time period.

3 - Paying Attention to Misconduct: How Firm Misconduct is Interpreted Differently in the Post-Sarbanes-Oxley Era

Jo-Ellen Pozner, University of California, Berkeley, Haas School of Business, Berkeley, CA, United States of America, pozner@haas.berkeley.edu, Colleen Stuart, Celia Moore

The consequences of organizational misconduct are the subject of much investigation by organizational scholars. Although research has identified negative consequences for individual directors and top managers, inconsistent results across studies suggest that consequences may not accrue equally to all managers and directors. More importantly, the role of different stakeholders in apportioning consequences and the degree to which organizational leaders' actions may protect themselves from such consequences have not yet been fully elaborated. In addition, little is known about how changes in the institutional environment affect corporate misconduct and its after-effects. In particular, regulatory punctuations after large-scale disruptions to business practice have the potential to change the way stakeholders respond to misconduct. By looking at the actions taken by internal and external stakeholders following revelations of misconduct before and after Sarbanes-Oxley, we explore these simultaneous gaps in the organizational misconduct literature. We argue that organizational misconduct is a stigmatizing event that leads both internal and external stakeholders to take purposive action in an attempt to avoid stigmatization. We analyze the effects of these actions on the degree to which both individual directors are stigmatized by association with organizational misconduct before and after the implementation of the Sarbanes-Oxley legislation.

4 - Struggles and Tournaments: A Conflict Model of the Emergence and Legitimacy of Chiropractic

Karen Patterson, University of New Mexico, Anderson School of Management, Albuquerque, NM, United States of America, Patterson@mgt.unm.edu, Marvin Washington

We contribute to the literature on institutional change examining how a nontraditional practice in an established field managed to exist and thrive, despite opposition, lack of traditional types of support, and lack of legitimacy. We do so by examining the role of chiropractic within the field of medicine, exhibiting the persistence of challenger practices and supporting the concept of institutional pluralism. Our research extends previous work by addressing the process of institutional change across levels of analysis.

■ SB13

Level 2 - Room 202A

NPD: From Design to Market

Cluster: New Product Development

Invited Session

Chair: Gulru Ozkan, Assistant Professor, Clemson University, Department of Management, 120B Sirrine Hall, Clemson, SC, 29634, United States of America, gulruo@clemson.edu

1 - Sell a Pig in a Poke or Let the Cat out of the Bag: Developing, Signaling, Learning and Screening Quality

Shouqiang Wang, Assistant Professor, Clemson University, 131D Sirrine Hall, Clemson, SC, 29634, United States of America, SHOUQIW@clemson.edu, Gulru Ozkan

This paper considers a firm that develops and sells a new experience product, whose quality may not be observable by the buyer with uncertain perceived quality, and evaluates the quality, pricing and timing strategy of the seller that offers a free time-locked product trial. We synthetically study three informational roles of such a trial program in communicating the product quality: signaling, learning and screening; and their implications on the seller's new product development strategy.

2 - Will Marie Antoinette Eat Bread? Quality Consciousness, Perceived Value and Product Design

Sreekumar Bhaskaran, Southern Methodist University, Dallas, TX, United States of America, sbhaskar@mail.cox.smu.edu, Karthik Ramachandran, Priyali Rajagopal

In this paper, we provide experimental evidence that the perceived quality of a product varies systematically with the quality consciousness of consumers. Specifically, more quality conscious consumers perceive low-end (or, high-end) products to be of even lower (or, higher) quality than less quality conscious consumers. Analytical implications of this new discovery are also explored.

3 - Identifying Styles in Product Design

Tian Chan, PhD, INSEAD, 1 Ayer Rajah Ave., Singapore, 138676, Singapore, tianheong.chan@gmail.com, Manuel Sosa, Jurgen Mihm

We introduce an approach to identify styles in product design. We built a theoretical foundation on what a style is and how designs are organized into styles. We then executed a graph-clustering algorithm to identify styles in design patents filed in the USA between 1976 and 2010. Our validation suggests that the algorithm performs no differently from humans. Finally, our analysis on the dynamics of styles suggests that the design world is becoming increasingly turbulent.

4 - New Product Development Evolution: The Search for the Best Alternative

Gulru Ozkan, Assistant Professor, Clemson University, Department of Management, 120B Sirrine Hall, Clemson, SC, 29634, United States of America, gulruo@clemson.edu, David Hall, Jeremy Hutchison-Krupat, Fred Switzer

Using a behavioral approach, we examine the strategy of decision makers who search for the best alternative to develop into a new product. The impacts of facing a set of radical or incremental set of alternatives and the level of time-pressure on the evolution of decision makers' performance are analyzed.

■ SB14

Level 2 - Room 202B

JFIG Paper Competition II

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering, Fayetteville, AR, 72704, United States of America, shengfan@uark.edu

Chair: Erhun Kundakcioglu, Assistant Professor, Ozyegin University, Nisantepe District, Orman Street, Istanbul, Turkey, erhunk@gmail.com

1 - JFIG Paper Competition

Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering, Fayetteville, AR, 72704, United States of America, shengfan@uark.edu

Papers are submitted for this year's JFIG paper competition, and each one is evaluated based on the importance of the topic, appropriateness of the research approach, and the significance of research contribution. In this session, finalists-selected in two rounds of review, will present their papers. For the selected finalists and the abstracts of the selected papers, please refer to the online program.

■ SB15

Level 2 - Room 203

Empirical Service Science Research

Sponsor: Service Science

Sponsored Session

Chair: Gregory Heim, Associate Professor, Texas A&M University, INFO Department Mays Business School, 320 Wehner Building 4217 TAMU, College Station, TX, 77843-4217, United States of America, GHeim@mays.tamu.edu

1 - Values of Artists under Equilibrium Framework

Jialie Chen, PhD Student, Marketing, Samuel Curtis Johnson Graduate School of Management, Cornell University, 301P Sage Hall, Ithaca, NY, 14850, United States of America, jc2428@cornell.edu

This paper estimates music artists' values identified as difference in profits under competitive equilibrium between two scenarios (market and counter-factual), where one artist "loses" value. Using BLP methodology and sales data for 2010-11, we find that Group artists have higher value than female or male solo artists.

2 - Impacts of Top Service Designers: Analysis of Golf Course Quality and Price

Seung Jun Lee, PhD Student, Texas A&M University, Department of Information & Operations M, 320 Wehner Building 4217 TAMU, College Station, TX, 77843-4217, United States of America, sjlee@mays.tamu.edu, Gregory Heim, Michael Ketzenberg

Service firms leverage talents of top designers who built their excellence upon past design successes and prior competitive performances to design better experiences. Using data on golf courses and top golf course designers, we study whether top designers and lead user designers influence quality and pricing of golf courses. Empirical results provide insights about possible impacts of using top and lead user designers.

■ SB16

Level 2 - Room 204

Personalized Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Abe Zeid, Northeastern University, Department of Mechanical & Industrial Engineering, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA 02115zeid@coe.neu.edu

Co-Chair: Sagar Kamarthi, Northeastern University, United States of America, sagar@coe.neu.edu

1 - Semantic Web Integration for Healthcare with Clinical Decision Support System

Clarence Augustine Tee, CEO/Professor, e-Oncologist, Stanford, 3505 El Camino Real, Palo Alto, CA, 94306, United States of America, catht@e-oncologist.com, Su Xie

Clinical decision support systems are receiving great attention today for improving quality of care. This paper proposes an integrated semantic web supported by key stakeholders to incorporate a comprehensive solution in bringing precision medicine closer to patients. We find that both patients and hospitals can potentially benefit tremendously by employing this novel architecture.

2 - Optimization Model and Decision Support to Implement Health Interventions to Diminish Readmissions

Andres Garcia-Arce, University of South Florida, 4202 E. Fowler Avenue, ENB 118, Tampa, Fl, 33620, United States of America, andresg@mail.usf.edu, Jose Luis Zayas-Castro

The 30-day preventable readmissions rate is a concept that has been linked to a problem of quality of service in the American healthcare system. From FY 2012 CMS has established a penalization factor in the IPPS for those hospitals that have higher rates of readmissions for three diseases. This work aims to study a new option from the health intervention approach that could help in the long run to develop a more sustainable improvement in the performance of the healthcare system.

3 - Dynamic Control of Excess Wait Times in Healthcare Systems
Sara Nourazari, PhD Student, Northeastern University, 360 Huntington Ave., Boston, MA, 02115, United States of America, sara@coe.neu.edu, James Benneyan, Rifat Sipahi

Excess wait time is a common problem in many health systems. Since the demand for service is not usually constant over time, capacity decisions play an important role in controlling delayed access in healthcare and can largely influence the patient wait time. Our research investigates the value of engineering feedback control to dynamically adjust staffing levels in order to achieve any predefined performance levels, including optimal minimal cost controllers under a variety of assumptions.

■ SB17

Level 2 - Room 205A

Service Modularization

Sponsor: Service Science

Sponsored Session

Chair: Tuure Tuunanen, Professor, University of Jyväskylä, PO Box 35, Mattilanniemi 2, Agora, Jyväskylä, 40014, Finland, tuure@tuunanen.fi

1 - Service Process Modularization in E-Stores' Supply Chains
Anu Bask, Postdocoral Researcher, Aalto University, Runeberginkatu 22-24, Helsinki, 00100, Finland, anu.bask@aalto.fi, Hilkka Merisalo-Rantanen, Tuure Tuunanen

Service offerings call for new modular service process design approaches in addition to traditional service design methods. In this study, the order-delivery process of e-stores' supply chain is examined by utilizing constructs of service process modularization, modular reuse, and modular variation. Also a framework for analyzing order-delivery process and its modularity is developed.

2 - Towards Assessing the Homogeneity of Service Architectures at the Market Level
Tilo Böehmann, Universität Hamburg, Germany, Vogt-Kölln-Strafle 30, Hamburg, 22527, Germany, Tilo.Boehmann@uni-hamburg.de, Regine Dörbecker, Torsten Harms

Recent research on service modularity emphasizes the concept of service architecture. This research lacks guidance for the operationalization of this concept and predominately uses firm-level, qualitative data. We propose an approach to assess quantitatively service architectures at the market level. We particularly study architecture homogeneity across service providers to understand to what extent market forces shape architectural decisions using quantitative data on German insurance services.

3 - Service Modularization Calls for Special Roles
Markku Kuula, Professor, Aalto University School of Business, POB 11000, 00076 Aalto, Helsinki, Finland, markku.kuula@aalto.fi, Antero Putkiranta, Pirjo Tulokas

The purpose of this paper is to examine how public services can be split into modules and, if is it possible to identify different roles for these modules. As research framework 'the strategic role of the plant' model by Ferdows (1997) is used. This study is a single case study using one case in the public sector. 'Ministry of Foreign Affairs (MFA)' was selected to the case organization, because it is currently developing its services.

4 - Assessing Product Service Systems (PSS): The Danish Maritime Industry
Juliana Hsuan, Professor, Copenhagen Business School, Department of Operations Management, Solbjer Plads 3, Frederiksberg, DK-2000, Denmark, jh.om@cbs.dk, Tim McAloone, Line Maria Neugebauer

We apply a management tool to classify different integrated PSS within the context of Danish maritime industry. We investigate how a firm should organize its operations to manage the transition from being a manufacturing to a servitizing company, and to provide a guideline for strategic positioning and planning of the balance between product sales and service activities.

■ SB18

Level 2 - Room 205B

Service Delivery

Sponsor: Service Science

Sponsored Session

Chair: Jeanette Blomberg, IBM Research Almaden, 650 Harry Rd., San Jose, CA, 95120, United States of America, blomberg@us.ibm.com

1 - Service Delivery Financial Performance
Ray Strong, IBM Research Almaden, 650 Harry Rd., San Jose, CA, 95120, United States of America, hrstrong@us.ibm.com, Jeanette Blomberg, Sechan Oh, Neil Boyette, Anca Chandra

We present anonymized and normalized evidence for hypotheses about cost and revenue behavior in long term IT service delivery contracts. For example, we provide support for the declining volatility of cost over project lifetimes. We discuss how we collect and analyze the raw data and the status of several hypotheses relevant to forecasting profitability. We also discuss how we draw conclusions from data generated by accounting practices that change over time.

2 - Design of Effective and Efficient Service Delivery Processes
Gang Li, Assistant Professor, Bentley University, Waltham, MA, 02452, United States of America, gli@bentley.edu, Joy Field, Mark Davis

A major challenge in service process design is balancing high levels of efficiency with high levels of customer service. We introduce a design approach that integrates back office and front office components of the service that creates opportunities to share employee resources. Based on the time sensitivity of activities and the relative efficiencies and costs of each employee type, our model determines the optimal allocation of employee types that provides a given service level at minimum cost.

3 - Finding an Optimally Representative View
Neil Boyette, Research, IBM Research Almaden, 650 Harry Rd., San Jose, CA, 95120, United States of America, nboyette@us.ibm.com, Sechan Oh, Ray Strong, Anca Chandra, Jeanette Blomberg

An analysis of the cost of service delivery is typically viewed in a reporting application, which allow various ways to filter and aggregate the data. Our system allows selecting one or more data points in a given view and finds the optimal combination of filters and aggregations to locate the likely causal explanation of this behavior. We use a segmented analysis of the original view to develop a score for each possible combination, as the usual branch & bound techniques do not apply.

■ SB19

Level 2 - Room 205C

Service Queues

Sponsor: Applied Probability

Sponsored Session

Chair: Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu

1 - Optimal Capacity Planning for RHN Health Network via Queueing Models and Simulation
Kimiebi Akah, Masters Candidate, Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, akah.5@osu.edu, Yue Tan, Cathy Xia

We consider the capacity planning problem for a health network of 6 hospitals with the goal of reducing costs while keeping service quality within target. The complexity of the problem creates difficulty for OptQuest with running the model. We consider distance based probabilistic routing, study the service quality of each hospital through G.G.C approximations, and derive the capacity planning solution. The robustness of the model is further demonstrated via simulation.

2 - Contract Design for Multi-sourcing Service
Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu, Ying Xu

Multi-sourcing is becoming increasingly popular in service industries, but prior work has paid limited attention to multi-sourcing management via contracts in service sectors. We build a queueing model in which a client firm outsources to two self-interested service providers, whose capacity decisions are influenced by the payment schemes offered by the client firm. We compare various performance-based payment schemes under different multi-sourcing structures.

3 - Multi-level, Multi-type Matching Queues
Sherwin Doroudi, Graduate Student, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, sdoroudi@andrew.cmu.edu, Kristen Gardner, Mor Harchol-Balter, Alan Scheller-Wolf

There is a newly emerging class of online games where players differ in both level and type. Players can only be matched if they have complementary types, with preference given to matches between similar levels. For example, native English speakers learning intermediate Spanish prefer native Spanish speakers learning intermediate English. We propose matching policies along with tools to analyze these policies under Markovian assumptions. We study tradeoffs between waiting time and match quality.

■ SB20

Level 2 - Room 205D

Queueing Models

Sponsor: Applied Probability

Sponsored Session

Chair: Ohad Perry, Assistant Professor, Northwestern University, Evanston, IL, United States of America, ohad.perry@northwestern.edu

1 - On Fluid and Diffusion Approximations for Finite Horizon Single-server Queueing Models
Harsha Honnappa, University of Southern California, Electrical Engineering, Los Angeles, CA, 90291, United States of America, honnappa@usc.edu, Amy Ward

We consider a finite horizon single-server queueing model in which n customer arrival times are sampled from a given distribution F, and service times are i.i.d.. We establish that the diffusion limit for this model, as n becomes large, is a function of a Brownian motion and a Brownian Bridge process, and is specified using the directional derivative of the one-dimensional Skorokhod map. The same diffusion limit arises for a class of conditioned "conventional" single-server queues.

2 - Diffusion Models and Steady-state Approximations for Exponentially Ergodic Markovian Queues
Itai Gurvich, Associate Professor, Northwestern University, 2001 Sheridan Road, Evanston, IL, United States of America, i-gurvich@kellogg.northwestern.edu

Motivated by queues with many-servers, we study Brownian steady-state approximations for continuous time Markov chains (CTMCs). Our approximations are based on diffusion models (rather than a diffusion limit). Within an asymptotic framework, in which a scale parameter n is taken large, a uniform Lyapunov condition is proved to guarantee that the gap between steady-state moments of the diffusion and those of the properly centered and scaled CTMCs, shrinks at a rate of the square root of n.

3 - Dynamic Spectrum Management, a Queueing Approach
Jiheng Zhang, Assistant Professor, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, j.zhang@ust.hk, Shining Wu, Rachel Q. Zhang

We consider a spectrum owner with limited channels, each serving one user at a time. †To increase the efficiency, he can serve both licensed and unlicensed users. While a licensed user has a higher priority, an unlicensed user only uses a channel for a fixed time x, and rejoins the queue for the remaining service if a licensed user is waiting. Otherwise, he can continue for another x amount of time. We evaluate the performances and seek optimal ways to manage the spectrum.

4 - Achieving Rapid Recovery in an Overload Control for Large-scale Service Systems
Ohad Perry, Assistant Professor, Northwestern University, Evanston, IL, United States of America, ohad.perry@northwestern.edu, Ward Whitt

We consider how two large service pools can help each other in a time-varying environment involving periods of overloads. In particular, we analyze a fluid approximation of the system and seek an automatic routing policy. We show that the fluid is bi-stable during periods of normal loads, with a periodic equilibrium. There is therefore a need to sacrifice some optimality so as to avoid congestion collapse due to the oscillatory behavior of the fluid model.

■ SB21

Level 2 - Room 206

Health System Design

Sponsor: Health Applications

Sponsored Session

Chair: Yue Zhang, Assistant Professor, University of Toledo, 2801 W. Bancroft St., Toledo, OH, 43606, United States of America, Yue.Zhang@utoledo.edu

1 - Incorporating Client Preferences into Preventive Care Network Design
Lijie Song, Zayed University, Dubai, Dubai, United Arab Emirates, song.lijie@me.com, Yue Zhang, Vedat Verter, Beste Kucukyazici

We present a study on preventive care network design. We first estimate a population level participation function, then use stated preference discrete choice modeling to explore clients' preference concerning facility attributes. Next we apply results from econometrics analyses to an empirically based simulation model, and use meta-heuristics to demonstrate how to improve preventive care network performance by incorporating client preferences.

2 - Medical Laboratory Network Design
Yue Zhang, Assistant Professor, University of Toledo, 2801 W. Bancroft St., Toledo, OH, 43606, United States of America, Yue.Zhang@utoledo.edu, Derek Atkins

This research presents a system-optimal and two user-choice models for designing a network of medical laboratories in a centralized environment, where a central decision maker determines the optimal location and capacity of each open facility so as to maximize overall social welfare. We propose a common solution methodology along with the location-allocation framework. Through a case study, we discuss several interesting managerial insights.

3 - Nursing Home Performance Evaluation on Patient-Centered Outcomes
Paul Hong, Professor, University of Toledo, 2801 W. Bancroft, Toledo, United States of America, hong@utoledo.edu, Yue Zhang, Huey-Shys Chen, Diane Salvador

In this research, we apply the Data Envelopment Analysis (DEA) technique to performance evaluation of nursing homes with the focus on patient-centered outcomes. The databased for our analysis contains 9622 nursing homes in the U.S. We find that for-profit nursing homes and nursing homes belonging to a chain are more efficient, and that the larger the nursing home, the more efficient.

4 - Hypertension Management: A Value of Information Approach
Manaf Zargoush, McGill University, 2107, 1411 Rue Du Fort, Montreal, H3H2N7, Canada, zargoush@gmail.com, Mehmet Gumus, Vedat Verter, Stella Daskalopoulou

Hypertension is one of the most prominent risk factors for the development of cardiovascular disease (CVD), the leading cause of morbidity and mortality worldwide. In this context, accurate measurement of blood pressure is vital. In this research we model two blood pressure measurement methods as Markov Decision Processes (MDP's) and analyze the value of information (VOI) attributed to these two methods. We also identify the optimal policies under each measurement scheme.

■ SB22

Level 2 - Room 207

Joint Session Healthcare\DM: Microbiome Data: Analyzing the DNA Content of Microbial Communities

Cluster: Healthcare Systems/Informatics & Data Mining

Invited Session

Chair: J. Paul Brooks, Virginia Commonwealth University, PO Box 843083, Richmond, VA, United States of America, jpbrooks@vcu.edu

1 - Statistical Analysis of Metagenomic Sequencing
Hongmei Jiang, Northwestern University, 2006 Sheridan Road, Wilmette, IL, 60208, United States of America, hongmei@northwestern.edu, Lingling An

In the past few years, the number of metagenomic projects in natural (such as soil and water) or host-associated (such as human gut and oral cavity) environments has grown exponentially. Based on the short reads sequencing data, we propose a mixture model to characterize the taxonomic composition of a metagenomic sample. The method is comprehensively tested on both simulated and real data, and is able to accurately identify and quantify multiple genomes.

2 - Model-based Clustering of Taxonomy Trees and its Application to Analysis of Human Microbiome Data

Patricio LaRosa, Washington University in St. Louis, School of Medicine, Department of Medicine, St. Louis, IL, United States of America, PLAROSA@dom.wustl.edu, William Shannon, Erica Sodergren, Yanjiao Zhou, Elena Deych, Berkley Shands, George Weinstock

Human microbiome research uses DNA sequencing technology to characterize bacteria living in and on us and how they impact our health. The data generated is represented as a taxonomy tree of bacteria. There is one such tree for each sample analyzed. In this talk, we will present a model for bacterial taxonomy trees and a clustering method of trees using a finite mixture model based on this model. Application of this method to the analysis of bacterial taxonomy trees from HMP will be presented.

3 - Interaction of Host Gene Expression and the Human Gut Microbiome in Pouchitis

Levi Waldron, Harvard School of Public Health, 655 Huntington Avenue, Boston, MA, 02115, United States of America, levi@jimmy.harvard.edu, Xochitl Morgan, Timothy Tickle, Curtis Huttenhower

Linking metagenomic profiles host phenotypes and biomolecular details is key to understanding roles of the microbiome in human disease. I will discuss recent work profiling host-microbe interactions using host gene expression and 16S metagenomic profiling in pouchitis. This work highlights class prediction and class comparison methodology for metagenomic data, where methods can be adopted from the microarray literature, and where new approaches are needed.

4 - The Truth about Metagenomics

J. Paul Brooks, Virginia Commonwealth University, PO Box 843083, Richmond, VA, United States of America, jpbrooks@vcu.edu

The human microbiome is the community of microbes that populate habitats on and around various body sites. The processing of DNA from microbiome samples introduces bias so that the relative quantities of bacteria that are observed are a distortion of the true population composition. Designed experiments and computational modeling identify sources of bias, quantify their impact, and facilitate the testing of specific hypotheses about the microbiome and disease.

■ SB23

Level 2 - Room 208A

Advances in Revenue Management and Pricing under Consumer Choice Models

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ruxian Wang, Assistant Professor, The Johns Hopkins Carey Business School, 100 International Drive, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu

1 - Competitive and Dynamic Pricing in a Inventory-concerned Duopoly

Varun Gupta, University of Texas-Dallas, Richardson, TX, United States of America, varun.gupta@utdallas.edu, Metin Cakanyildirim

We study dynamic and competitive pricing that sell a generic product to the same market. Retailers dynamically price the product while taking the inventory levels into consideration. We develop a choice model based on preferences to model customer choices. Further, we also discuss the application of this model in specific applications such as airline revenue management and employee recruitment.

2 - New Approach to Pricing Personalized Product Bundles with Multi-Commodity Configurations

Zizhuo Wang, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, zwang@umn.edu, Markus Ettl, Zhengliang Xue

We study a method to price personalized packages of multiple commodities, e.g. hardware, software and service. The seller has to deal with a customized package without any sales history. A top-down and bottom-up approach is applied to estimate the demand elasticity from the historical sales data for various configurations. We establish a utility model to characterize each package and calculate the dependency among the commodities. The business impact is justified based on the price optimization.

3 - A Unified Method for Constrained Assortment and Pricing Problems under the Nested Logit Model

Ruxian Wang, Assistant Professor, The Johns Hopkins Carey Business School, 100 International Drive, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu

We propose a unified method for finding the optimal solution to the constrained assortment and pricing problems under the nested logit model. The efficient are uniquely determined by the desired adjusted markups, which are also linked to a common variable at the nested level. The product selection search space is reduced to the set of efficient assortments of polynomial size. Finally, the joint optimization can be reduced to a single-dimensional problem with jump-up discontinuity.

■ SB24

Level 2 - Room 208B

Personalization in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Roger Lederman, IBM Research, Yorktown Heights, NY, United States of America, rdlederm@us.ibm.com

1 - Does Field Price-discretion Improve Profits? Evidence from Auto Lending

A. Serdar Simsek, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, ASimsek13@gsb.columbia.edu, Garrett van Ryzin, Robert Phillips

In many markets, headquarters create a price list while local salespeople have discretion to negotiate prices for individual deals. We investigate how much (if any) pricing discretion to grant using two data sets –one from an online lender and one from an indirect lender with local pricing discretion. We find that local sales force adjusts prices in a way that improves profitability and this discretion introduces endogeneity into the pricing process, which leads to significant estimation bias.

2 - Price Negotiation and Extended Warranty in a Distribution Channel

Chia-Wei Kuo, National Taiwan University, No. 1, Sec 4, Roosevelt Road, Taipei, 106, Taiwan - ROC, cwkuo@ntu.edu.tw, Sean Zhou, Kwei-Long Huang

We consider a distribution channel in which a manufacturer sells the product through a retailer to the end market. The manufacturer uses the wholesale-price-only contract while the retailer can determine the pricing policy – posted pricing or negotiation, and whether to bundle the product with extended warranty. We discuss effects of various forms of cost structures on the optimal decisions and equilibrium outcome.

3 - Dynamic Assortment Customization with Limited Inventories

Fernando Bernstein, Professor, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, fernando.bernstein@duke.edu, Safak Yucel, Lei Xie

We consider a retailer with limited inventories of substitutable products. The firm decides which subset of products to offer to each arriving customer. The optimal policy is to offer all available products if the customer base is homogeneous. However, with multiple customer segments characterized by different product preferences, it may be optimal to limit the choice set of some customers. Using a case study, we find that the revenue impact of assortment customization can be significant.

4 - Hierarchical Customization of Product Assortments under Ranking-based Consumer Choice

Roger Lederman, IBM Research, Yorktown Heights, NY, United States of America, rdlederm@us.ibm.com, Denis Saure

We study assortment-planning settings where consumers engage in a multi-stage selling process and product assortments are presented in an incremental fashion. Incremental information about consumer preferences is obtained and can be used to customize product offerings in later stages. We address computation of optimal assortment policies and quantify the value of hierarchical customization in consumer screening and inventory rationing.

■ SB25

Level 2 - Room 208C

Algorithmic Mechanism Design

Cluster: Auctions

Invited Session

Chair: Vahab Mirrokni, Senior Staff Research Scientist, Google Research NYC, 542 W 112th Street, New York, NY, 10025, United States of America, mirrokni@google.com

1 - Combinatorial Walrasian Equilibrium

Brendan Lucier, Researcher, Microsoft Research, One Memorial Drive, Cambridge, MA, United States of America, brlucier@microsoft.com, Michal Feldman, Nick Gravin

We study a combinatorial market design problem with indivisible objects. We introduce the notion of Combinatorial Walrasian equilibium (CWE), where the seller packages items into indivisible bundles then sets linear prices on the bundles so that none are over-demanded. We devise a poly-time algorithm that converts any given allocation into a CWE while reducing its social welfare by at most half. This implies there always exists a CWE yielding half of the optimal social welfare.

2 - Distributed Content Curation on Social Networks

Zeinab Abbassi, PhD Student, Columbia University, New York, NY, United States of America, za2153@columbia.edu, Nidhi Hegde, Laurent Massoulie

There has been an explosion of digital content in recent years on online platforms such as blogs and social networks, video sharing, and original content. We consider the problem on curating this vast catalogue of content in a way that aggregators or publishers can offer readers content that is of interest to them, with minimal spam. Under a game-theoretic model we obtain several results on the optimal content selection and on the eefficiency of distribution curation.

3 - Exchange Market Mechanisms without Money

Nima Haghpanah, PhD Student, Northwestern University, Evanston, IL, United States of America, nima.haghpanah@gmail.com, Vahab Mirrokni, Zeinab Abbassi

This paper considers a set of agents who wish to obtain a set of items, and have a set of items to offer to others. An exchange market mechanism specifies for each agent a subset of items to give away, and a subset of items to receive. Each agent would like to maximize the number of items he receives. Our goal is to design truthful mechanisms to maximize social welfare. This problem is a generalization of the kidney exchange problem, and is motivated by barter exchange websites on the Internet.

4 - Cost-recovering Bayesian Algorithmic Mechanism Design

Balasubramanian Sivan, PhD Student, University of Wisconsin-Madison, 1210 W Dayton St., Madison, WI, 53706, United States of America, balu2901@cs.wisc.edu, Hu Fu, Brendan Lucier, Vasilis Syrgkanis

Consider a group of participants competing to receive service from a mechanism that can provide such services at a cost. The mechanism aims to serve agents to maximize social efficiency, without suffering an expected loss: the agents' payments should cover the service cost in expectation. We develop a general method for converting arbitrary approximation algorithms for the underlying optimization problem into Bayesian incentive compatible mechanisms that are cost-recovering in expectation.

■ SB26

Level 2 - Room 208D

Energy Issues in Facility Location

Sponsor: Location Analysis

Sponsored Session

Chair: Ho-Yin Mak, The Hong Kong University of Science and Technology, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, hymak@ust.hk

Co-Chair: Michael Lim, Assistant Professor, University of Illinois, 1206 S. 6th Street, Champaign, IL, 61822, United States of America, mlim@illinois.edu

1 - Assessing Energy Use and Charging Facilities for Plug-in Hybrid Electric Vehicles

Xing Wu, Assistant Professor, Lamar University, 4400 MLK Parkway, Cherry Engineering RM 2032, Beaumont, TX, 77706, United States of America, xwu1@lamar.edu

Electrification of transportation is widely regarded as an effective solution to the energy security, global warming and pollutant emissions. Plug-in hybrid electric vehicles (PHEVs) can operate on gasoline when the battery is depleted. Using longitudinal travel data of 331 vehicles over 18 months in the Seattle metropolitan area, we aim to find the optimal battery capacity and charging facility coverage for PHEVs from the prospective of customers and policymakers, respectively.

2 - Food, Energy, and Environment Trilemma: Sustainable Farmland Use and Biofuel Industry Development

Xin Wang, University of Illinois at Urbana-Champaign, 111 E Healey St., Apt. 202, Champaign, 61820, United States of America, wangxin1@illinois.edu, Michael Lim, Yanfeng Ouyang

With limited farmland, stimulating the growth of the biofuel industry while protecting food security and preserving environmental sustainability is a difficult trilemma. We propose a continuous approximation based game-theoretic model to capture multiple stake-holders' behaviors (food, energy, and environment). We obtain insights on the impact of the emerging biofuel industry, and provide subsidy guidelines on how policy-makers should intervene to achieve socially favorable farmland use.

3 - Hierarchical Coordinated Control of Plug-in Electric Vehicles Charging in Multi-family Dwellings

Wei Qi, University of California, Berkeley, Berkeley, CA, 94720, United States of America, qiwei@berkeley.edu, Zhiwei Xu, Z. Max Shen

We study electric vehicles charging coordination problem in multi-family dwellings. Various communities can access electric power through a common distribution transformer. We first formulate a centralized charging control problem to maximize the total utility of the charging service provider while satisfying customer demands and transformer capacity constraints. We then propose a decentralized problem and demonstrate its applicability in terms of computational efficiency and system reliability.

4 - Flexible Urban Car Sharing System Design and Operations

Guangrui Ma, PhD Candidate, Hong Kong University of Science and Technology, Dept. of IELM, Room 3208, Kowloon, Hong Kong - PRC, magr@ust.hk, Ho-Yin Mak

Car sharing is becoming a popular solution to balance individual mobility needs and sustainability. But the unbalanced and time-variant usage behavior makes it difficult to match driving demand and vehicle availability. In this paper, we propose the use of pricing as a complementary solution to the direct repositioning strategy. We consider the use of surcharge pricing to adjust vehicle flow among different zones based on demand dynamics. Finally, we compare the efficiency of the two strategies.

■ SB27

Level 2 - Room 209A

DoD Big Data Analytics: : New Applications, Opportunities, and Roadmaps

Sponsor: Military Applications

Sponsored Session

Chair: Aaron D Burciaga, Senior Scientist, Elder Research, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, burciaga@dataminginglab.com

1 - Using Virtualization Technologies to Enable a Mobile IaaS System for Tactical Edge Data Analytics

Albert Barreto, Lecturer, Naval Postgraduate School, 1411 Cunningham Road, Suite GW3006, Monterey, CA, 93943, United States of America, abarreto@nps.edu, Dan Boger, Charles Ibatuan

Lessons learned by NPS HFN teams sent to Katrina and Haiti have shown a gap existed in the ability to respond quickly. By deploying a mobile EOC with existing HFN comms and power, C2 is enhanced with advanced analytics. The EOC in a box runs VMware to host a complete Windows and VDI suite. C2 uses ArcServer with 10 TB of local geospacial data for predictive analysis. Additionally, USHAHIDI Crowdsourcing and Lighthouse Social Networking applicaiton devloped at NPS are hosted.

2 - Weaponizing Data: New Principles of Advanced Analytics and Data Stewardship in Military Decisions

Aaron D Burciaga, Senior Scientist, Elder Research, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, burciaga@dataminginglab.com

To compete and win future operational challenges, the DoD and Services must "Weaponize Data"which is the application of advanced analytics to data through rigorous processes to maximize the application and operational impact of decision making information. We present a Big Data Analytics framework for the DoD to overcome the stubborn paradigms of siloed data, unfederated information systems, and ungoverned analytic processes.

3 - Evading Moore's Law: Quantum Computing for Operations Research

Dan Davis, Research Liaison MHPCC, University of Southern California, Information Sciences Institute, 6275 E. 6th Street, Long Beach, CA, 90803, United States of America, ddavis@hpc-educ.org, Robert Lucas, Ke-Thia Yao, Thomas Lucas, Gene Wagenbreth

The end of Moore's Law growth impels a review of advanced computing, paying special heed to the real needs and pressing issues of management scientists. After four decades of high performance computing, the authors now use quantum computing to implement OR applications. They discuss technology promises and pitfalls, focusing their remarks on how adiabatic quantum annealing will assist DoD decision-making and enable effective processing of the data generated by new computer and sensor systems.

■ SB28

Level 2 - Room 209B

Joint Session Doing Good/SPPSN: Doing Good with Good OR I

Cluster: Doing Good with Good OR & Public Programs, Service and Needs

Invited Session

Chair: Jérémie Gallien, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, jgallien@london.edu

1 - Doing Good with Good OR - Student Paper Competition

Jérémie Gallien, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, jgallien@london.edu

Doing Good with Good OR - Student Paper Competition is held each year to identify and honor outstanding projects in the field of operations research and the management sciences conducted by a student or student group that have a significant societal impact.

2 - Optimal Batch Processing Stochastic Gradient Method for Adaptive Bayesian Classification: An Application to On-line Electroencephalogram Signal Processing

Fatemeh Hashemi, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, fatemeh.s.hashemi@gmail.com

We propose optimal sampling strategies within Simulation Optimization(SO) problems, which best serves rapid parameter updating in settings that demand fast decision-making owing to the urgent nature of the questions posed. We apply our method for brains; signal classification towards online brain-computer interfaces and demonstrates its superiority over other sampling methods within SO context.

3 - Guiding School Choice Reform through Novel Applications of Operations Research

Peng Shi, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-149, Cambridge, MA, 02139, United States of America, pengshi@mit.edu

In January 2012, Boston launched a school assignment reform. After attending many community meetings, I proposed a series of optimization-based plans to balance various objectives. I also fitted a discrete choice model and rigorously simulated alternative plans. In March 2013, Boston adopted the plan I proposed. This will benefit the 8000+ families who apply to Boston elementary schools each year.

4 - Offer or No Offer: Managing Foreclosed Housing Acquisitions in Societal Response to Foreclosures

Armagan Bayram, Doctoral Candidate, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, abayram@som.umass.edu, Senay Solak

We consider two practical decision frameworks for community development corporations (CDCs) in acquiring and redeveloping foreclosed properties. For both cases we derive analytical results and calculate optimal property value impact thresholds that a CDC can use to determine the properties to seek funding for. We also emphasize several insights based on a numerical study involving a CDC.

■ SB29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - JMP Software from SAS

Jian Cao, Systems Engineer, SAS Institute, SAS Campus Drive, Cary, NC, 27513, United States of America, jian.cao@jmp.com

JMP® is the SAS® software that links robust statistics with interactive graphics, in memory and on the desktop. JMP is also an analytic hub, integrating with SAS, R, Excel and MATLAB, to provide a point and click user interface. JMP's tools for interactive exploratory data analysis and statistical modeling will be demonstrated. Also reviewed will be new features in JMP 11 including generalized models, repeated measures/mixed models, response screening, uplift, and categorical data.

2 - American Optimal Decisions - Portfolio Safeguard (PSG): Advanced Nonlinear Mixed-Integer Optimization Package

Stan Uryasev, American Optical Decisions, Gainesville, FL, United States of America, uryasev@aorda.com

Portfolio Safeguard is an advanced nonlinear mixed-integer optimization package used in risk management, statistics, financial engineering, military, medical and other applications. Design and solve complex optimization problems with built-in functions (maximum, StDev, variance, probability, VaR, CVaR, Drawdown, cardinality, fixed-charge, spline, recourse etc.) See real-life case studies at www.aorda.com/aod/psg.action.

■ SB30

Level 2 - Room 210B

Workforce Flexibility and Productivity

Cluster: Workforce Engineering and Management

Invited Session

Chair: Yun Fong Lim, Singapore Management University, 50 Stamford Rd. #04-01, Singapore, Singapore, yflim@smu.edu.sg

1 - The Value of Increased Worker Qualification in Rail Dispatcher Scheduling

Tony Craig, Postdoctoral Associate, Massachusetts Institute of Technology, 77 Massachusetts Ave., E40-211, Cambridge, MA, 02139, United States of America, tcraig@mit.edu

When an unplanned absence occurs among rail dispatchers, the absence must be filled using a scheduled extra board dispatcher or an overtime worker. Dispatchers may only work positions at which they are qualified, and the number of qualifications is small compared to the number of positions. We analyze data on historical absences, and use simulation to estimate the value of extra qualifications compared to increased staffing levels and a willingness to use overtime.

2 - Workforce Scheduling with Learning by Doing and Learning from Others

Frank Bentefouet, Project Leader-Distribution Insights, Liberty Mutual, 175 Berkeley Street, Boston, MA, 02116, United States of America, frank.bentefouet@libertymutual.com, David Nembhard

We investigate the allocation of workers to tasks based on individual learning characteristics to improve system throughput. The worker productivity includes learning by doing and learning by transfer of knowledge from others. The allocation problem is composed of: a selection phase , a grouping phase and an assignment phase. At each phase, heuristic approaches are suggested. Two systems are of interest: a parallel system and a serial system.

3 - Tandem Queues with Non-collaborative Flexible Servers and Set-up Costs

Tugce Isik, Georgia Tech, Atlanta, GA, United States of America, tugceisik@gatech.edu, Sigrun Andradottir, Hayriye Ayhan

Consider a system of two queueing stations in tandem with a finite intermediate buffer and two flexible servers who are unable to collaborate. Revenue is collected when jobs leave the system, and set-up costs are incurred when servers move between stations. We completely characterize the server assignment policy that maximizes the long-run average profit for arbitrary revenue, set-up cost, and buffer size, and analyze the limiting behavior of the optimal policy as the buffer size increases.

4 - Cellular Bucket Brigades on U-lines with Discrete Work Stations
Yun Fong Lim, Singapore Management University, 50 Stamford Rd. #04-01, Singapore, Singapore, yflim@smu.edu.sg, Yue Wu

We propose an operating protocol to coordinate workers on a U-line with discrete stations. Under the protocol the system can be configured such that its productivity is maximized. Workers are allowed to dynamically share work so that the system can effectively absorb the impact of variability. Increasing the number of stations in each stage from one to two may improve productivity significantly, but further dividing the U-line into more stations has diminishing return.

■ SB31

Level 2 - Room 211A

Modeling and Computation in Financial Engineering

Sponsor: Financial Services

Sponsored Session

Chair: Ning Cai, Assistant Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, ningcai@ust.hk

1 - Simulated Likelihood for Jump-diffusions
Gustavo Schwenkler, Boston University, 595 Commonwealth Ave., Boston, MA, 02215, United States of America, gschwenk@stanford.edu, Kay Giesecke

We develop and analyze likelihood estimators for the parameters of a discretely observed jump-diffusion. The drift, volatility, jump intensity, and jump size are arbitrary functions of the state. The estimators are based on a novel representation of the transition density that facilitates the exact computation of the density via Monte-Carlo simulation. We provide conditions guaranteeing consistency and asymptotic normality as the sample period grows. Numerical results illustrate our approach.

2 - Bond Portfolio Optimization for Impact of Credit Contagion
Wendy Roth, Georgia State University, 1043 College of Business, Atlanta, GA, United States of America, wroth@gsu.edu, Chanaka Edirisinghe, Aparna Gupta

Portfolios are constructed to achieve maximum risk-adjusted returns. An unanticipated event impacting securities issued by one firm can spread to other firms due to connections existing between firms, potentially resulting in a contagion effect. This can adversely affect the level of tail risk in a portfolio, especially when a number of connected firms are included in a portfolio. An optimization developed to evaluate contagion related risk in a portfolio of debt instruments is examined.

3 - International Reserve Management: A Drift Switching Reflected Jump-diffusion Model
Ning Cai, Assistant Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, ningcai@ust.hk, Xuewei Yang

We propose a drift switching reflected double exponential jump-diffusion model for international reserve management to capture both the jump behavior in reserve dynamics and the leptokurtic feature of the reserve increment distribution. The model is simple and produces a closed-form expression for the total expected discounted cost of managing reserves.

4 - Risk Analysis of Exchange-Traded Funds (ETFs)
Tim Leung, Assistant Professor, Columbia University, IEOR Department, 500 West 120th Street MC4704, New York, NY, 10027, United States of America, tl2497@columbia.edu

In the US, the Exchange-traded fund (ETF) market has grown from a dozen funds in 1995 to over a thousand funds with over $1.5 trillion in assets in 2013. For many investors, ETFs provide various desirable features such as liquidity, diversification, low expense ratios and accessibility to different markets and positions. In this talk, we will discuss the price dynamics and risks of ETFs as well as their options.

■ SB32

Level 2 - Room 211B

Entrepreneurship, Innovation and Technology Management

Sponsor: Technology Management

Sponsored Session

Chair: Sinan Erzurumlu, Babson College, 231 Forest St., Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Innovation, Openness & Platform Control
Geoffrey Parker, Tulane University, Freeman School of Business, New Orleans, LA, 70115, United States of America, gparker@tulane.edu, Marshall Van Alstyne

We examine how exercising control over a technology platform can increase profits and innovation. By choosing how much to open and when to bundle enhancements, platform sponsors can influence ecosystem partner choices. Results can inform innovation strategy, choice of organizational form, antitrust and intellectual property law, and competition management.

2 - The Overconfident Entrepreneur's Role in the Evolution of Innovation
Jennifer Bailey, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, United States of America, Jennifer.Bailey@scheller.gatech.edu

We explore the existence of overconfident entrepreneurs as a necessary ingredient for the introduction and persistence of radical innovations. We consider how vicarious learning impacts the decisions of individual agents to invest in radical innovation under different industry performance selection environments.

3 - Pioneering Choices: The Good, the Bad, the Policy Opportunity, the Good
Moren Levesque, Professor, York University, 4700 Keele Street, Toronto, ON, M3J 1P3, Canada, MLevesque@schulich.yorku.ca, Richard Arend

We provide a mathematical model of pioneering strategic choice that differs from those in the first-mover literature in terms of the extent to which we assume pioneers can mold the 'profit equation' involved in commercializing invention. We find an interesting pattern of outcomes arising from the strategic choices possible, including some outcome areas where expected inefficiencies can be addressed through effective policy to improve overall welfare.

4 - Fire in the Belly? Employee Motives and Innovative Performance in Startups versus Established Firms
Henry Sauermann, Georgia Institute of Technology, 800 W. Peachtree St., Atlanta, GA, 30308, United States of America, Henry.Sauermann@scheller.gatech.edu

We compare startup employees' pecuniary and non-pecuniary motives with those of employees working in small and large established firms, and examine the extent to which existing differences in motives distinguish employees' innovative performance. Using data on over 10,000 U.S. R&D employees, we find significant differences in motives and innovative performance across firm types and the former partly explain the latter.

■ SB33

Level 2 - Room 211C

Railway Applications Society: Problem Solving Competition

Sponsor: Railway Applications

Sponsored Session

Chair: Sandra Eksioglu, Associate Professor, Mississippi State University, PO Box 9542 206 McCain Engineering Bld., MSSTATE, MS, 39762, United States of America, sde47@ise.msstate.edu

1 - RAS 2013 Problem Solving Competition
Jagadish Jampani, CSX Transportation, 500 Water St., J300, Jacksonville, FL, 32216, United States of America, Jagadish_Jampani@csx.com

Participants are asked to build a model which can be used to identify a plan that optimizes the operations of a railroad yard. The goal of an operations plan is to minimize the total waiting time of railcars in the yard and maximize the total number of railcar processed during a certain period.

■ SB34

Level 2 - Room 211D

Joint Session I-Sim/QSR: Dynamic Data Driven Modeling and Analysis of UAVs and UGVs

Sponsor: Simulation Society & Quality, Statistics and Reliability

Sponsored Session

Chair: Young-Jun Son, Professor, The University of Arizona, Engineering Blg #20, Room #111, Systems, The University of Arizona, Tucson, AZ, 85721, United States of America, son@sie.arizona.edu

Co-Chair: Jian Liu, The University of Arizona, 915 North Tyndall Avenue, Tucson, AR, 85721, United States of America, jianliu@email.arizona.edu

1 - DDDAMS-based Surveillance and Crowd Control via UAVs and UGVs

Amirreza M. Khaleghi, PhD Student, University of Arizona, Systems and Industrial Engineering, The University of Arizona, Tucson, AZ, 85721, United States of America, amirreza@email.arizona.edu, Dong Xu, Young-Jun Son

A DDDAMS-based planning and control framework is proposed, which 1) devises a best control strategy via crowd detection, tracking, and motion planning in agent-based simulation, 2) controls real UAVs/UGVs via monitoring, data processing, task generation, and execution, and 3) adjusts modeling scales over time adapting to system performance and computations. Experimental results demonstrate system robustness against various configurations, crowd coverage improvement, and computational savings.

2 - Information Aggregation/Disaggregation Based Crowd Tracking using UAVs and UGVs

Mingyang Li, Research Assistant, University of Arizona, Tucson, AZ, United States of America, mingyangli@email.arizona.edu, Jian Liu, Zhenrui Wang

Tracking crowds of people with UAVs and UGVs receives increasing attention in applications such as border patrol and crowd surveillance. The complementary characteristics of UAVs and UGVs indicate that aggregating/disaggregating information collected from both sides can significantly improve the tracking performance. This paper proposes a Bayesian inference framework to implement such aggregation/disaggregation. A case study is conducted to demonstrate the effectiveness of the proposed approach.

3 - Following a Group of Targets in Large Environments

Jyh-Ming Lien, Assistant Professor, George Mason University, Computer Science, Fairfax, VA, 22030, United States of America, jmlien@cs.gmu.edu, Christopher Vo, Sam McKay

The problem of following multiple coherent targets is called the group following problem. While camera tracking is well studied, the group following problem has not gained much attention despite that there are many scenarios where it is desired to maximize the visibility of moving targets. In this work, we address the scalability issue by investigating the idea of cached visibility. In this work, we show that cached visibility provides better balance between efficiency and performance.

■ SB35

Level 2 - Room 212A

Digital Media

Sponsor: E-Business

Sponsored Session

Chair: Jui Ramaprasad, Assistant Professor, McGill University, Desautels Faculty of Managemen, 1001 Sherbrooke West, Montreal, QC, H3A1G5, Canada, jui.ramaprasad@mcgill.ca

1 - Social Connectedness and Adoption of Online Music Sites

Genevieve Bassellier, Associate Professor, McGill University, Desautels Faculty of Managemen, 1001 Sherbrooke St. W., Montreal, QC, H3A 1G5, Canada, genevieve.bassellier@mcgill.ca, Zachary Krastel, Jui Ramaprasad

In recent years a great diversity of models for online music sites has emerged. These models differ not only in terms of format, genre, and price of music offered, but also in the extent to which they support social connectedness amongst consumers and with artists. This survey-based study examines users' perceptions of features and their role in influencing adoption of online music sites.

2 - On the Temporal Nature of Sales to Rank Relationships of Digital Music

Ramnath Chellappa, Associate Professor, Emory University, 1300 Clifton Rd., Atlanta, GA, 30322, United States of America, ramnath.chellappa@emory.edu

A significant amount of work in IS, economics and marketing has used a sales-rank relationship to impute demand from the relative sales-rank of a product in its category. However many industries, in particular the music industry are subject to temporal changes suggesting that the sales to rank relationship may not be fixed. Analyses of weekly album-sales data not only reveals statistically different sales distribution week-to-week, but also significant differences in this relationship.

3 - Social Network-based Marketing, Revisited

Shawndra Hill, University of Pennsylvania, Philadelphia, PA, United States of America, shawndra@wharton.upenn.edu, Adrian Benton

We compare the predictive performance of a social network-based recommendation engine across product and user categories. The prediction task is to predict which of more than 600 brands in 15 industry categories web users follow on Twitter. We explore various features of both users and brands and show how these features interact when making social network-based predictions.

4 - Streaming vs. Downloading of Online Music: Complements or Substitutes?

Jui Ramaprasad, Assistant Professor, McGill University, Desautels Faculty of Managemen, 1001 Sherbrooke West, Montreal, QC, H3A1G5, Canada, jui.ramaprasad@mcgill.ca, Sanjeev Dewan

Online music models have evolved over the past decade, from a single option of purchasing full albums to downloading and streaming of individual songs. Using streaming and radio play data for a set of songs released in early 2011, we examine the relationship between streaming and downloading using the literature on innovation co-diffusion as our framework. Our results shed light on whether streaming and downloading are substitutes or complements to one another.

5 - The Effect of Movie Streaming on the Consumption of TV

Rodrigo Belo, Carnegie Mellon University, Pittsburgh, PA, United States of America, rbelo@cmu.edu, Miguel Matos, Pedro Ferreira

Time shifted television increases the alternatives that consumers can choose and allows them to bypass programs from different networks for free. This empowers consumers at the expense of content providers and advertisers and raises the marginal cost to provide service. In this paper we characterize some of the changes that time shifted TV is triggering on TV consumption and discuss the implications for consumers and industry stakeholders alike.

■ SB36

Level 2 - Room 212B

Joint Session SPPSN/DAS: Community-Based Operations Research

Sponsor: Public Programs, Service and Needs & Decision Analysis

Sponsored Session

Chair: Michael Johnson, Associate Professor, University of Massachusetts Boston, Dept of Public Policy and Public Affairs, 100 Morrissey Blvd., Boston, MA, 0212503393, United States of America, michael.johnson@umb.edu

1 - Community-based Analytics: Big Data and Decision Modeling for Community-based Organizations

Michael Johnson, Associate Professor, University of Massachusetts Boston, Dept of Public Policy and Public Affairs, 100 Morrissey Blvd., Boston, MA, 0212503393, United States of America, michael.johnson@umb.edu, Merritt Hughes

Community-based organizations face significant challenges in identifying data needs, and assembling data resources for service provision, strategy design and advocacy. We develop principles by which CBOs can develop and share large datasets in order to formulate and solve decision problems that improve the well-being of localized, often marginalized or distressed communities. We illustrate these ideas using field research from Boston, MA.

2 - A New Methodology for Investigating Health Disparities
Chester Spell, Associate Professor, Rutgers University Camden, School of Business, 227 Penn Street, Rm 331, Camden, NJ, 08102-1656, United States of America, cspell@camden.rutgers.edu, Katerina Bezrukova, Alok Baveja

A challenge in understanding disparities in health between communities is evaluating the effect of multiple disparity-related factors (e.g., disease incidence, location, access to care). Using the emerging concept of macro-faultlines, or alignment of characteristics that individuals within a population share, we develop an innovative method that assesses 'total health disparity.' The goal is to address community-based disparities and preventive-health strategies in a more informed manner.

3 - Homeless Family Shelter Policy and Operations Management
Natalie Privett, Assistant Professor of Management and Policy, New York University, Wagner Graduate School of Public Service, 295 Lafayette St., 2nd Floor, New York, NY, 10012, United States of America, natalie.privett@nyu.edu, Gordon Campbell

This project investigates the intersection of public policy, decision making and operations planning for the New York City homeless family shelter system, exploring the complexities and operational implications of policy decisions as well as the nuances of forecasting and planning in the context of homeless services. We examine data, interviews, and financial information spanning the full lifecycle of Advantage in New York City, the only jurisdiction in the U.S. that provides shelter on demand.

■ SB37

Level 2 - Room 213A

Recent Trends in Deterministic Scheduling Research

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Christos Koulamas, Florida International University, 11200 SW 8th Street, Miami, FL, 33199, United States of America, Koulamas@fiu.edu

1 - Index Priority Rules with Variable Job Processing Times
George Kyparisis, Florida International University, 11200 SW 8th Street, Miami, FL, 33199, United States of America, kyparis@fiu.edu

We consider single-machine makespan minimization problems with time-dependent job processing times given by general multiplicative/additive functional forms. We show that the linear function is the only function leading to an index priority rule for such problems with multiplicative/additive job deterioration functions.

2 - Schematic Representation of Some Flow Shop Scheduling Problems
S.S. Panwalkar, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, panwalkar@jhu.edu, Christos Koulamas

The classical minimum makespan flow shop model and its variations involving three or more machines have been generally found to be NP hard. In analyzing these models, many researchers have proposed various schematic diagrams representing a specific schedule. While such diagrams cannot directly result in solutions, they do help provide a better understanding of the problem structure. In this paper we discuss various flow shop problem formulations and schematics including some new ones.

3 - A Mixed Packing-sequencing Problem in the Delivery of Chemotherapy Drugs
Federico Della Croce, D.A.I. Politecnico di Torino, Corso Duca degli Abruzzi 24, Torino, 10129, Italy, federico.dellacroce@polito.it, Andrea Grosso, Jean-Charles Billaut

We consider a problem arising in chemotherapy drugs delivery where drugs are stored in vials. Once a vial is opened, it must be used before a time limit. The aim is to minimize the drugs waste and satisfy the treatment requests. The problem can be seen as a 2-constraint bin packing problem with additional due dates on the treatments execution inducing jobs sequencing constraints. A matheuristic and a recovering beam search are proposed and tested on bin packing instances with/without due dates.

■ SB38

Level 2 - Room 213B

Recent Advances in Modeling Terrorists' Judgments for Counter-Terrorism Analysis

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Gilberto Montibeller, Tenured Lecturer in Decision Sciences, London School of Economics, Houghton Street, London, WC2A2AE, United Kingdom, G.Montibeller@lse.ac.uk

1 - Allocating Defensive Resources for Disengaging Terrorist Attack Intensions
Marcelo Zawadzki, Instituto de Estudos Avançados, Trevo Coronel Aviador José Alberto, Albano do Amarante, n. 1 - Putim, Sao José dos Campos, SP, 12.228-001, Brazil, M.Zawadzki1@lse.ac.uk, Mischel Belderrain, Gilberto Montibeller

This paper presents a descriptive/prescriptive methodology, in a game theoretic style, which allows prescriptive advices to decision makers who must allocate defence resources to mitigate the risk of a terrorist attack. Unlike traditional approaches which aim to define the best protection for the higher risks, we seek for the best allocation overall that disengages the opponent at most to perform any sort of attack.

2 - Contrasting Decision Models for Different Adversary Groups
Heather Rosoff, Research Assistant Professor, University of Southern California, CREATE, RTH-315, MC-2902, Los Angeles, CA, 90089-2902, United States of America, rosoff@usc.edu, Richard John

Terrorists and other adversaries generally have multiple and conflicting objectives that underlie attack motivations. For two separate terrorists groups, we have looked at the value structure, risk attitudes, trade-offs among conflicting objectives, and the estimated success probabilities for different attacks. In this presentation, we demonstrate model structure differences across the two groups, as well as report probabilistic estimates of attacker behavior for the two groups.

3 - Adversarial Risk Analysis for Urban Security Resource Allocation
Jesus Rios, IBM T.J. Watson Research Center, Yorktown Heights, NY, United States of America, jriosal@us.ibm.com, David Rios Insua, Cesar Gil

We explore how Adversarial Risk Analysis (ARA) may be used to allocate security resources to protect urban spaces. We take into account the spacial structure and consider both proactive and reactive measures in that we aim at both trying to reduce criminality and recover as best as possible from it, when it happens. The proposed model is illustrated with a simple example.

4 - In the Opponent's Shoes: Modeling Terrorists' Judgments
Sumitra Sribhashyam, London School of Economics, Houghton Street, London, United Kingdom, S.Sribhashyam@lse.ac.uk, Gilberto Montibeller

One way to anticipate terrorists' actions is to consider their judgments when modeling their potential decisions so proper counter-terrorism measures may be adopted. We review and discuss the suitability of assumptions made across such models from a descriptive point of view. We explore the modeling implications by drawing knowledge from fields surrounding terrorism. We present a way of addressing some of these areas: dynamic priorities, utilities and beliefs using MCDA and System Dynamics.

■ SB39

Auditorium 3

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Sulum Optimization - Optimization for Servers and Cloud Computing at Competitive Prices
Bo Jensen, CEO, Sulum Optimization, Kaasvaenget 45, Middelfart, 5500, Denmark, bo.jensen@sulumoptimization.com

Sulum Optimization Tools is a high performance optimization engine for solving network, linear, and integer problems. This talk will present the most recent improvements. In particular we will cover our new Cloud Solver and demonstrate how to solve optimization problems on remote servers or in the cloud with easy to manage software tools.

2 - Numerical Algorithms Group – Mathematical Software to Address Your Business Needs
Brian Spector, Technical Sales Specialist, NAG, 801 Warrenville Rd., Ste. 185, Lisle, IL, 60532, United States of America, spector@nag.com

Do you need to make your numerical code more efficient and accurate but don't know where to begin? We will demonstrate some of the 1,700 mathematical and statistical functions using the Numerical Algorithms Group (NAG) Library from MATLAB and Excel. Examples covered include optimization, regression, nearest correlation matrix, and more.

■ SB40

Auditorium 2

Auctions and Trading Agents

Cluster: Auctions

Invited Session

Chair: Wolf Ketter, Associate Professor, Erasmus University, Rotterdam School of Management, Rotterdam, Netherlands, WKetter@rsm.nl

1 - Towards Flexible Decision Support in Multi-unit Sequential B2B Auctions
Yixin Lu, PhD Candidate, Erasmus University, Rotterdam School of Management, Burgemeester Oudlaan 50, T9-16, Rotterdam, 3062PA, Netherlands, ylu@rsm.nl, Eric van Heck, Alok Gupta, Wolf Ketter

We develop a structural model for multi-unit sequential Dutch auctions in a complex B2B context. To the best of our knowledge, this is the first study that explicitly models the sequential aspects of Dutch auctions using structural econometric analysis. Further, we demonstrate how the structural properties can be used to perform policy counterfactuals and develop intelligent software agents that facilitate auctioneer's real-time decision making.

2 - Airline Price Prediction to Optimize Ticket Purchase Time
William Groves, PhD Student, University of Minnesota, 200 Union St., SE Ste 4-192, Minneapolis, MN, 55455, United States of America, groves@cs.umn.edu, Maria Gini

Airline ticket prices change with demand and due to competitive actions by other airlines. We propose a method which combines domain knowledge provided by the user with systematic search to obtain a feature set which is optimal for predicting prices and optimizing purchase time. The constraints used for feature set selection prevent overfitting and improve prediction even with small data sets. Experiments show average cost reductions of 7.2 percent on both international and domestic routes.

3 - A Broker Agent for Smart Grid Balancing
Daniel Urieli, PhD Candidate, The University of Texas at Austin, 2317 Speedway, Stop D9500, Austin, TX, United States of America, urieli@utexas.edu, Peter Stone

The 'Smart Grid' vision includes incorporating clean, renewable, distributed energy sources into the electricity grid. This creates major challenges in the form of (1) balancing electricity production and consumption at all times, under uncertain generation and consumption (2) encouraging customer participation. The talk will focus on a broker agent that aims at addressing these challenges. The broker is fully implemented and tested in the PowerTAC smart grid simulation environment.

4 - A Simple Ascending Auction for Assignment Problems
De Liu, University of Kentucky, 425D Gatton B&E Building, Lexington, KY, 40506, United States of America, de.liu@uky.edu

We introduce a simple ascending auction that allocates heterogeneous objects among bidders with purely private unit demands. Our auction design economizes information needed from bidders, uses a simple and intuitive price adjustment procedure, and accommodates explicit reserve prices. Despite these features, it stops in a finite time, has a sincere bidding ex-post Nash equilibrium, and the ending prices and revenue depend only on reserve prices.

■ SB41

Level 1 -101A

Achieving Social Responsibility in Supply Chains

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Soo-Haeng Cho, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, soohaeng@andrew.cmu.edu

Co-Chair: Robert Swinney, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, robert.swinney@duke.edu

1 - The Impact of Supply Chain Structure on Responsible Sourcing
Ruixue Guo, Doctoral Student, Stanford University, Stanford, CA, 94305, United States of America, rguo@stanford.edu, Hau L. Lee, Robert Swinney

We analyze the sourcing decisions of firms that may choose between two types of suppliers: responsible suppliers that are costly but follow strict social and environmental responsibility standards, and normal suppliers that are less costly but may randomly experience responsibility violations. We explore how three structural elements of the supply chain influence the firm's optimal sourcing decision: downstream competition, concentration of the supplier base, and supply chain flexibility.

2 - A Dynamic Mechanism for Achieving Sustainable Quality Supply
Jeannette Song, Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, jingsheng.song@duke.edu, Fang Liu, Tracy Lewis

Several leading companies have realized the importance of sustainable quality supply and initiated programs to achieve it. One example is Starbucks' C.A.F.E. Practices. This paper investigates whether the guidelines in such programs provide the right incentives and information structures for all parties to participate, to achieve the intended long-term goals. The participation by the retailer includes her investment in supplier development.

3 - Supplier Evasion of a Buyer's Audit: Implications for Auditing and Compliance
Terry Taylor, University of California, Berkeley, Haas School of Business, Berkeley, CA, United States of America, taylor@haas.berkeley.edu, Erica Plambeck

Many brands have recently been tarnished by publicity of suppliers' labor and environmental violations, and have responded by increasing their auditing efforts. Suppliers seek to pass audits not only through efforts to comply with standards, but also through efforts to deceive auditors. We characterize when auditing backfires by increasing deception effort and reducing a supplier's effort to comply with labor and environmental standards.

4 - Combating Child Labor: Incentives and Information Transparency in Supply Chains
Ying Xu, PhD Student, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, yingx1@andrew.cmu.edu, Sridhar Tayur, Soo-Haeng Cho

An estimated 158 million children aged 5-14 are engaged in child labor. Besides poverty in underdeveloped countries, extensive outsourcing has slowed child labor reform by encouraging firms to seek low labor costs. This paper examines the incentive of a multinational firm to induce or combat child labor via its supply contract and internal monitoring. We then investigate the potential effects of the new legislation in the U.S. that requires disclosures on corporate efforts to combat child labor.

■ SB42

Level 1 -101B

Assortment Planning

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Yalcin Akcay, Koc University, Rumelifeneri Yolu, Sariyer, Istanbul, 34450, Turkey, yakcay@ku.edu.tr

1 - Pricing, Assortment and Inventory Decisions under Cross Selling
Bacel Maddah, American University of Beirut, Bliss Street, Beirut, Lebanon, bm05@aub.edu.lb, Ahmed Ghoniem, Ameera Ibrahim

We formulate a nonlinear integer program that jointly optimizes a retailer's decisions on assortment, pricing, and inventory for two complementary categories, primary (e.g. toys) and secondary (e.g. batteries). Decisions of the two categories are coupled by asymmetric cross-selling, where a stream of customers who purchase from the primary category would also buy from the secondary category. We show that an exact linear reformulation of the problem exists, and draw managerial insights.

2 - Product Line Design under Demand Uncertainty: Market Segmentation Versus Risk Pooling
Ying Rong, Shanghai Jiao Tong University, No. 535 Fahua Road, Shanghai, 200052, China, yrong@sjtu.edu.cn, Ying-Ju Chen, Z. Max Shen

This paper investigates the impact of demand uncertainty on the firm's product line decision and production strategy. We argue that the presence of supply-demand mismatch may significantly influence the product line design decisions due to the interplay between the market segmentation and risk pooling effects.

3 - Assortment Planning of Configurable Products
Ratna Babu Chinnam, Professor, Wayne State University, 4815 Fourth St., Detroit, MI, United States of America, Ratna.Chinnam@wayne.edu, Edward Umpfenbach

Producers of configurable products such as automobiles often struggle to balance supply chain complexity with sufficient customer choice. We present a model designed for automotive OEMs to tackle this problem objectively. Our model simultaneously accounts for variant driven complexity, feature packaging opportunities, and sustainability considerations.

4 - Planning for Availability with Service Level Requirements
Hari Natarajan, Associate Professor, University of Miami, hari@miami.edu, Yalcin Akcay, Hernan Awad

We study a seller's inventory planning problem for an assortment of products facing random customer demand. The seller chooses the optimal inventory levels so as to satisfy product-specific and assortment-based service level requirements. The service level measure used in this study is the ready rate of the assortment.

■ SB43

Level 1 -101C

Empirical Research in Operations / SCM

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Anupam Agrawal, University of Illinois, 363 Wohlers Hall, Champaign, IL, 61821, United States of America, anupam@illinois.edu

1 - How Does Organization Structure Affect Supply Chain Performance?
Anupam Agrawal, University of Illinois, 363 Wohlers Hall, Champaign, IL, 61821, United States of America, anupam@illinois.edu

We explore a detailed real life experiment in which a firm had different organizational structures in its two divisions, and these different structures infuenced the quality of the sourced components in the two divisions differently. We show how buyer organization redesign can create a learning environment at the suppliers, and if this redesign is not done, then the learning environment and thereby the incoming quality can be different.

2 - The Diseconomies of Pooling in a Discretionary Task Setting: An Investigation of ED Length of Stay
Hummy Song, PhD Student, Harvard Business School, Morgan Hall 480, Soldiers Field Road, Boston, MA, 02163, United States of America, hsong@hbs.edu, Anita Tucker, Karen Murrell

We conduct an empirical investigation on the impact of pooling demand on throughput time in a discretionary work setting. We propose that the benefits of a reduction in social loafing outweigh the expected efficiency gains from pooling, which are commonly predicted by queuing theory. Using an Emergency Department's patient-level data (N = 233,781) over 4 years, we find that patients' lengths of stay were longer when the ED's work system had pooled demand as opposed to dedicated demand streams.

3 - Sources of Innovation Failures
Kingshuk Sinha, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Ujjal Mukherjee

An integrative framework is proposed that relates 'technology life cycle' of a product to the 'stages of product development and manufacturing process' in identifying causes of innovation failures. The constituent hypotheses of the framework are empirically tested through analysis of a "big" panel data set on medical device recalls.

4 - Firm Performance in Dynamic Environments: The Role of Operational Slack and Operational Flexibility
Manpreet Hora, Georgia Institute of Technology, 800 West Peachtree Street, NW, Atlanta, GA, 30075, United States of America, Manpreet.Hora@scheller.gatech.edu, Jeremy Kovach, Pankaj Patel

This study examines operational slack and operational flexibility under two components of environmental dynamism - unpredictability and instability. We collect data on 964 publicly traded firms in 23 industries from the years 1998 to 2007 (representing 8,473 firm year observations). Using panel data analysis, we find that operational flexibility is beneficial in highly unpredictable markets, whereas operational slack is beneficial in highly unstable markets.

■ SB44

Level 1 -101D

Cooperation in Firm Network Management

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Laurens Debo, Associate Professor, University of Chicago, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu

1 - Comparison of Product Take-back Compliance Schemes
Eda Kemahlioglu-Ziya, UNC-Chapel Hill, CB 3490, Chapel Hill, NC, United States of America, eda_kemahliogluziya@unc.edu, Gokce Esenduran

Under take-back legislation, the most common compliance scheme is collectively with cost allocation by market share. An alternative is individual compliance. We compare these schemes based on cost to the manufacturer and on environmental benefits. We show that high collection targets and large market shares among partner firms make collective compliance more cost effective. We provide insights on the tradeoff between collection rate targets and the effectiveness of incentives for recyclability.

2 - The Implications of Product Modularity for Leasing vs. Selling
Sezer Ulku, Georgetown University, Washington, DC, United States of America, su8@georgetown.edu, Vishal Agrawal, Atalay Atasu

Product architecture (i.e., integral vs. modular) and business model (i.e., selling vs. leasing) choices are two key strategic decisions. In this paper, we investigate a firm's joint choice of product architecture and business model, and identify when and how leasing and product modularity enhance or hurt the economic and environmental performance of a firm.

3 - Green Recycling Networks
Fang Tian, Ph.D. Candidate, University of Southern California, Marshall School of Business, IOM Department, BRI 401, Los Angeles, CA, 90089-0809, United States of America, tianfang@usc.edu, Greys Sosic, Laurens Debo

By analyzing two important determinants of recycling costs, economies of scale and material-stream heterogeneity, we discuss the impact of Extended Producer Responsibility legislation on recycling coalitions. We study coalitions that emerge endogenously when producers manage recycling, compared with coalitions organized by governments to minimize recycling costs and coalitions to maximize social welfare. We conclude by discussing implications of social welfare when implementing taxes/subsidies.

4 - Managing Decentralized Resource Sharing in Multicommodity Networks under Demand Uncertainty
Luyi Gui, The Paul Merage School of Business, University of California, Irvine, Irvine, CA, 92697, United States of America, luyi.gui@gatech.edu, Ozlem Ergun

We study the use of market-based exchange mechanisms to motivate and regulate capacity sharing so as to achieve the optimal overall routing efficiency in a general multi-commodity network such as a transportation or a telecommunication system. A practical challenge to do this arises from demand uncertainty. In this research, we characterize how network structure affects the robustness of the mechanism under demand uncertainty, and propose robust capacity pricing strategies accordingly.

■ SB45

Level 1 -101E

Sustainable Operations on Electricity and Green Business Models

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Ruben Lobel, University of Pennsylvania, The Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu

1 - Demand Response in Energy Markets: Voluntary and Involuntary Load Curtailment Contracts

Kaitlin Daniels, The Wharton School, 3730 Walnut Street, JMHH Suite 500, Philadelphia, PA, 19104, United States of America, kaitd@wharton.upenn.edu, Ruben Lobel

As energy consumption grows, electricity grids are turning to demand response (DR) to meet peak demand and lower prices. These programs allow forgone energy consumption to be sold on the market during peak demand events. This project compares the performance of two types of Dr. contracts: involuntary, under which consumers relinquish control of their energy consumption in return for payment, and voluntary, which allow consumers to decide to reduce their load during each peak event.

2 - Impact of Electricity Pricing Policy on the Investment of Renewable Energy

Safak Yucel, Duke University, 100 Fuqua Drive, Durham, United States of America, safak.yucel@duke.edu, Gurhan Kok, Kevin Shang

We study the effect of time-based pricing policies on renewable energy investment. We show that different pricing policies may lead to opposite effects on renewable energy investment of utilities, independent power producers (IPP) and the households. In contrast with the expectations of policy makers, we show that renewable energy investment of IPPs and utilities may be encouraged by flat pricing. We also investigate the effect of subsidies on carbon emissions and renewable energy investment.

3 - Shared Transportation Systems: The Role of Stockouts

Ashish Kabra, INSEAD, Fontainebleau, France, ashish.kabra@insead.edu, Karan Girotra, Francis de Véricourt

Shared urban transportation systems have the potential to reduce urban pollution, relieve traffic congestion and increase economic activity in cities, while offering the convenience of personally owned vehicles. While the conveniences of the systems are manifold, the systems expose consumers to the risk of stockouts. We analyze data on stockouts from different operational systems and identify its impact and superior facility locations that might limit stockouts.

4 - Is it More Valuable to Store or Destroy Electricity Surpluses?

Yangfang Zhou, Assistant Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Rd., Singapore, 178899, Singapore, helenzhou@smu.edu.sg, Alan Scheller-Wolf, Nicola Secomandi, Stephen Smith

A typical strategy for dealing with commodity surpluses is to store them for future sale; this storage strategy is a natural choice for dealing with electricity surpluses when wide scale storage is possible. However, because electricity prices can be negative, there exists another potential strategy: To buy electricity surpluses at negative prices and dispose of them. Our analysis suggests that the disposal strategy can be even more valuable for an electricity merchant than the storage strategy.

■ SB46

Level 1 -101F

Commodities and Operational Decision Making

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: John Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - Benefit and Coordination of Sharing Commodity Inventory

Seung-Jae Park, Ph.D. Candidate, McCombs School of Business, 2110 Speed way, Austin, TX, 78712, United States of America, Seung-Jae.Park@phd.mccombs.utexas.edu, Guoming Lai, Sridhar Seshadri

This paper studies the benefit and the coordination of inventory sharing when there are spot and forward markets. We consider two firms that use a common commodity input to satisfy stochastic demands in a multi-period setting. We propose a simple method to coordinate inventory sharing. The proposed method is fair for the borrower and lender and seems to work very well, i.e., the procurement cost gap between the centralized and decentralized cases is dramatically small in our experiments.

2 - Analysis and Enhancement of Practice-based Methods for Commodity Storage Real Option Management

Nicola Secomandi, Associate Professor, Carnegie Mellon Unversity, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ns7@andrew.cmu.edu

Practitioners manage commodity storage assets as real options using the rolling intrinsic and rolling basket of spread options heuristic policies. This research provides novel structural and numerical support for the use of these policies and enhances them by developing a simple and effective dual upper bound to be used in conjunction with these policies.

3 - Effect of Futures Price Information on the Procurement Policies

Ankur Goel, Case Western Reserve University, Cleveland, OH, United States of America, axg312@case.edu, Genaro Gutierrez

We develop a modeling framework that incorporates the dynamically evolving futures prices to negotiate forward contracts with the supplier when procurement cycle is not synchronized with the maturity of the futures contracts. We test our model using multi-factor, single-factor, and regression based price models on futures prices from CME and NYMEX. We conclude that regression based models perform better than more complex single-factor price model, but worse than the multi-factor price models.

4 - Network Exploitation of a Nonrenewable Resource

Rene Caldentey, New York University, Stern School of Business, 44 West Fourth Street, New York, United States of America, rcaldent@stern.nyu.edu, Denis Saure

We consider the problem of optimal exploitation of a nonrenewable resource for which the sequence of extraction can be modeled using a direct graph. Nodes in the graph represent specific pockets (blocks) where the resource is concentrated. Arcs are used to model the paths (feasible sequencing) that can be used to extract these blocks. We assume that the market price of this resource changes stochastically over time.

■ SB47

Level 1 -101G

Innovation in Service Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Pnina Feldman, University of California-Berkeley, 545 Student Services Bldg, #1900, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu

Co-Chair: Jose Guajardo, Assistant Professor, Haas School of Business, University of California Berkeley, Berkeley, United States of America, jguajardo@haas.berkeley.edu

1 - Skill and Capacity Management in Large-scale Marketplaces

Gad Allon, Professor, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Eren Cil, Achal Bassamboo

We characterize the optimal skill screening mechanism of a firm moderating a large-scale service marketplace where the ability of a service provider to cater customers, who can be of two classes, varies. We show that when the values that a service provider generates for each customer class are independent, the firm may need to refuse some of the service providers via its screening mechanism whereas this is never optimal when these values are perfectly correlated.

2 - Operational Advantage and Design Recommendations of Threshold Discounting Offers

Simone Marinesi, INSEAD, 257 Rue Saint Martin, Paris, 75003, France, Simone.MARINESI@insead.edu, Karan Girotra, Serguei Netessine

We study the use of Threshold Discounting offers, commonly employed by Groupon and other players in the "online discounted deals" industry, when a service provider faces strategic customers. We find that these offers improve operational performance compared to traditional approaches, and we provide guidelines on how to correctly design them.

3 - Innovation in the Delivery of Services
Kamalini Ramdas, Deloitte Chaired Professor in Innovation & Entrepreneurship, London Business School, A215 Sussex Place, Regent's Park, London, United Kingdom, kramdas@london.edu

I will present an overview of recent and ongoing research projects with multiple coauthors, focusing on innovation in the delivery of services. We consider major innovations in service delivery that simultaneously improve quality and reduce cost. We examine how these innovations alter four key areas of delivery: the service interaction, the service boundary, service tasks and the service location. I will present examples from healthcare and other service industries based on this work.

4 - Try Before You Buy: Consumer Learning in Rental Markets
Pnina Feldman, University of California-Berkeley, 545 Student Services Bldg, #1900, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu, Jose Guajardo, Dimin Xu

Rental markets have expanded to non-traditional settings, including markets for exclusive goods. While introducing rental markets may cannibalize sales, it may also benefit firms. We investigate how the interplay between the sales and rental markets is affected by the presence of consumer learning.

■ SB48

Level 1 -101H

Incentives in Sourcing

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Elena Katok, Ashbel Smith Professor, University of Texas at Dallas, Jindal School of Management, 800 W. Campbell Dr., Richardson, TX, 75080, United States of America, ekatok@utdallas.edu

1 - Using Procurement Service Providers in Supplier Screening: Theory and Laboratory Experiments
Zhixi Wan, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 S Six Street, Champaign, IL, 61820, United States of America, wanzhixi@illinois.edu, Sripad Devalkar, Hong Yuan

A buyer hires a PSP to conduct preliminary screening and recommend suppliers from a supplier pool for the buyer's final screening. The PSP can exert costly effort to identify "promising suppliers"; however, such effort is often difficult for the buyer to include in her contract. Using a game-theoretic model, we find the buyer's optimal strategy that minimizes her total expected costs. We test test our theoretic findings in laboratory.

2 - One Step at a Time: Impact of Separation on Multi-dimensional Decisions
Karthik Ramachandran, Assistant Professor, Georgia Institute of Technology, Scheller College of Business, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu, Yusen Xia

An intuitive approach to minimize the complexity of multi-dimensional decisions is to separate the dimensions. We develop a model of joint and separated decision-making for bounded-rational agents, and conduct behavioral experiments to test our predictions.

3 - Relational Investment in Production with Incomplete Contracts
Owen Ma, University of Texas-Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, owenma@utdallas.edu, Suresh Sethi, Ernan Haruvy, Elena Katok

Incomplete contracts may involve a hold-up problem, resulting in inefficient levels of investment. We model it as a sequential move game with asymmetric information. Absence behavioral considerations, equilibrium implies zero investment. However, with reciprocal motives, the hold-up problem may be mitigated by a credible threat. We propose such a model. In addition, we look at reputation as an alternative mechanism for mitigating the problem. We conduct experiments to test predictions.

4 - The Signaling and Incentive Effects of Supplier Awards
Ruth Beer, PhD Candidate, University of Michigan, Ross School of Business, 701 Tappan, Ann Arbor, MI, 48109, United States of America, ruthbeer@umich.edu, Stephen Leider, Hyun-Soo Ahn

Many firms recognize the importance of supplier performance by giving out a "Supplier of the Year" award to reward their suppliers' efforts. We show, both theoretically and experimentally the existence of two contrary effects: On one hand, these symbolic awards may have motivational effects on the recipient's behavior. On the other hand, giving out an award to a supplier gives a signal to other buyers that this supplier is good, intensifying the competition to get the good supplier.

■ SB49

Level 1 -101I

Sparse Solutions to Complex Models

Cluster: Tutorials

Invited Session

Chair: Xin Chen, Associate Professor, University of Illinois at Urbana-Champaign, 104 S. Matthews Avenue, Urbana, IL, 61801, United States of America, xinchen@illinois.edu

1 - Sparse Solutions to Complex Models
Xin Chen, Associate Professor, University of Illinois at Urbana-Champaign, 104 S. Matthews Avenue, Urbana, IL, 61801, United States of America, xinchen@illinois.edu, Chung Piaw Teo

Recent years witnessed the proliferation of the notion of sparsity and its applications in operations research models. To bring to the attention and raise the interest of operations research community on this topic, we present in this tutorial a wide range of complex models which admit sparse yet effective solutions. Our examples range from compressed sensing, optimization problems, game theory models,and two-stage stochastic programs with a few applications.

■ SB50

Level 1 -101J

Integrated Assessment Models for Climate Policy Design

Cluster: Climate Change and OR

Invited Session

Chair: Thomas Rutherford, Professor, University of Wisconsin Madison, AAE Department, 427 Lorch Street, Madison, WI, 54706, United States of America, rutherford@aae.wisc.edu

1 - A New Tool for Climate Policy Analysis: The US-REGEN Model
James Merrick, Stanford University, Mgmt. Science and Engineering, 475 Via Ortega, Stanford, CA, 94305, United States of America, jmerrick@epri.com, David Young

The US-REGEN model is a general equilibrium model of the US economy, with a detailed representation of the electric power sector. The model is designed to answer questions relating to regional and national climate policy design, particularly questions that assess the role of technology development and availability. This talk will provide an overview of the model's novel features, including the representation of renewables, power market regulatory structure and end-use electricity demand.

2 - Transfer Payments in Global Climate Policy
Florian Landis, ZEW Mannheim, L7, 1, Mannheim, 68161, Germany, landis@zew.de, Thomas Bernauer

We combine global climate modeling with regional welfare analysis to estimate regional carbon prices under various climate change, emissions and economic scenarios. Differences in regional carbon prices motivate transfer payments, if a global carbon price was to emerge. Results indicate that distributional matters can be discussed using arguments of cost-benefit analysis and we highlight to what extent the different uncertainties inherent to the analysis affect estimates of transfer payments.

3 - Energy and Climate Decisions Under Uncertainty: A Computable General Equilibrium Analysis
Mort Webster, Massachusetts Institute of Technology, Cambridge, MA, United States of America, mort@mit.edu, Jennifer Morris

We present a two-stage stochastic dynamic computable general equilibrium model to explore electricity technology choice under policy uncertainty. We demonstrate the expected welfare-maximizing amount of non-carbon backstop to use in the first stage when the future cap is uncertain. We also explore the impacts of a safety valve and uncertainty in backstop cost on first stage decisions, with tradeoffs between expected penalty for exceeding the cap and expected cost of stranded vintage capital.

4 - The Social Cost of Stochastic and Irreversible Climate Change
Yongyang Cai, Stanford University, 424 Galvez Mall, Stanford, CA, United States of America, yycai@stanford.edu, Thomas Lontzek, Kenneth Judd

There is great uncertainty about how CO2 emissions will affect economic welfare. DSICE is a DSGE extension of DICE. DSICE uses empirically plausible parameters for Epstein-Zin preferences to represent attitudes towards risk, and models uncertainty about future damages. This DSICE case implies carbon taxes much higher than implied by deterministic models, and indicates that optimal policies are much more sensitive to uncertainty than previously thought.

■ SB51

Level 1 -102D

Vehicle Sharing Systems

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Michal Tzur, Tel Aviv University, Department of Industrial Engineering, Faculty of Engineering, Tel Aviv, 69978, Israel, tzur@eng.tau.ac.il

1 - Fair Cost Sharing Mechanisms for Last Mile Ridesharing

Shih-Fen Cheng, Assistant Professor, Singapore Management University, 80 Stamford Road, Singapore, 178902, Singapore, sfcheng@smu.edu.sg, Duc Thien Nguyen, Hoong Chuin Lau

We consider a dynamic mechanism for last-mile ride-sharing on a non-dedicated commercial fleet. This problem is addressed as two sub-problems: vehicle routing and cost sharing. We propose auction mechanisms to elicit willing payments from passengers. We show that our mechanisms are budget balanced, fair, and incentive compatible. We also show how the winner determination problem can be solved efficiently. A real-world case study is presented to show the effectiveness of our approach.

2 - Inventory Rebalancing and Vehicle Routing in Bike Sharing Systems

Willem-Jan van Hoeve, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, vanhoeve@andrew.cmu.edu, Jasper Schuijbroek, Robert Hampshire

A major cost driver in bike sharing systems is rebalancing the bike inventory at the stations over time. We propose a new cluster-first route-second heuristic in which the polynomial-size clustering problem simultaneously considers the service level requirements and approximate routing costs. Extensive computational results on real-world data are provided, which show that our heuristic outperforms a pure mixed integer programming formulation and a constraint programming approach.

3 - Discrete Event Simulation Analysis of a Reservation-based Car Sharing System with One-way Journeys

Matthew Petering, Assistant Professor, University of Wisconsin Milwaukee, 3200 North Cramer St., EMS E367, Milwaukee, WI, 53211, United States of America, mattpete@uwm.edu, Liping Li

We use a discrete event simulation model to analyze the performance of a reservation-based car sharing system that allows one-way journeys. The model appears to be unique in the literature in that it (1) explicitly models the state of the online reservation system in continuous time; (2) provides a full animation of car pick-ups, journeys, and drop-offs; and (3) explicitly includes the rental of extra parking time at a car's pick-up and drop-off location in the car reservation process.

4 - Parking Reservations in Vehicle Sharing Systems

Michal Tzur, Tel Aviv University, Department of Industrial Engineering, Faculty of Engineering, Tel Aviv, 69978, Israel, tzur@eng.tau.ac.il, Mor Kaspi, Tal Raviv

We propose a Complete-Parking-Reservation (CPR) policy in vehicle sharing systems, where a user has to declare her destination when attempting to rent a vehicle. A vacant parking space is reserved for her if one is available. Otherwise, the transaction is denied. The CPR policy is compared to a No-Reservation (NR) policy. We prove that the CPR policy performs better than the NR under reasonable conditions and verify it via an extensive simulation study of large realistic systems.

■ SB52

Level 1 -102E

Innovative Applications of Routing Problems I

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Fahrettin Cakir, University of Iowa, 108 John Pappajohn Business Building, Iowa City, 52242, United States of America, fc.cakir@gmail.com

1 - The Min-max Multi-depot Vehicle Routing Problem: Three-stage Heuristic and Computational Results

Xingyin Wang, Department of Mathematics, University of Maryland, College Park, MD, 20742, United States of America, wangxy@umd.edu, Bruce Golden, Edward Wasil

The min-max multi-depot vehicle routing problem is a variant of the standard multi-depot problem. The objective is to minimize the total time of the most costly route taking into account travel time and customer service time. We develop a heuristic that produces high-quality solutions that compare favorably to previous results.

2 - Very Large Scale Vehicle Routing with Spherical Clustering

Fahrettin Cakir, University of Iowa, 108 John Pappajohn Business Building, Iowa City, 52242, United States of America, fc.cakir@gmail.com, Nick Street, Barrett Thomas

We develop a cluster-first, route-second technique that solves large scale vehicle routing problems using spherical clustering techniques. We obtain comparable solutions in terms of runtime and quality on benchmark instances.

3 - Robust Empty Trailer Repositioning in Large-scale Transportation Networks

Ilke Bakir, Georgia Tech, 765 Ferst Dr. NW, Atlanta, GA, 30332-0205, United States of America, ilkebakir@gatech.edu, Alan Erera

We propose a robust optimization approach for empty trailer repositioning decisions on large-scale transportation networks, based on flows on a time-expanded network, where arc flows correspond to trailer movements. It addresses the uncertainty in loaded trailer demand by using point estimates and uncertainty ranges for each loaded demand. With good robustness parameters, our approach significantly reduces the unsatisfied trailer demand, while not increasing the execution costs vastly.

4 - Allocating Slots for Import Containers in Container Terminal Yards with Uncertain Pick-up Sequences

Pengfei Zhou, pfzhou@yeah.net, Anne Goodchild

An uncertain pick-up order model is considered to reduce rehandling in container terminals, while also capturing uncertainty in truck arrival times. A least-second reshuffle based heuristic algorithm is proposed to reduce the reshuffle ratio. The experiments reveal that the proposed method could improve the relocation performance in reasonable time.

■ SB53

Level 1 -102F

Facility Logistics I

Sponsor: Transportation Science & Logistics/Facility Logistics

Sponsored Session

Chair: Sadan Kulturel-Konak, Professor of Management Information System, Pennsylvania State University, Tulpehocken Rd., PO Box 7009, Reading, PA, 19610, United States of America, sadan@psu.edu

1 - A Real-time Decision Support System for Pandemic Response

Sunderesh Heragu, Professor, University of Louisville, 580 S Preston St., Louisville, KY, 40202, United States of America, s.heragu@louisville.edu, Mehdi Zakerifar

In this talk, we present a real-time decision support system (RTDSS) that uses real-time date for pandemic response. The RTDSS includes several modules including those for location of strategic national stockpile (SNS) and their routing to points of dispense during a natural or manmade disaster, real-time allocation of emergency medical service (EMS), fire and police vehicles to patients in need, SNS distribution planning, mass vaccination simulation, emergency department (ED) planning, dispatch of mental health professionals to first responders, module to allocate patients to hospitals and others.

2 - Models for Automated Storage and Retrieval Systems with Multiple In-the-Aisle Pick Positions

Faraz Ramtin, University of Central Florida, 4000 Central Florida Blvd., Orlando, FL, 32816, United States of America, faraz.ramtin@knights.ucf.edu, Jennifer Pazour

We develop expected travel time models for different operating policies and physical configurations to analyze automated storage and retrieval systems with multiple in-the-aisle pick positions, which are case-level order-fulfillment technology. We develop closed-form approximations for the case of an infinite number of pick positions that enables us to derive the optimal shape configuration that minimizes expected travel times.

3 - Generic Simulation Model for Assembly Line Supply

Veronique Limere, Post-doctoral researcher, Ghent University, Technologiepark 903, Zwijnaarde, 9052, Belgium, Veronique.Limere@UGent.be, Kurt De Cock, El-Houssaine Aghezzaf

A simulation model for materials supply to mixed-model assembly lines will be discussed. The simulation model is created in FlexSim by means of an automatic model generator and demonstrates the in-plant logistical flows involved to supply parts from the warehouse to the assembly line. The results of the simulation model are compared to those of a deterministic mixed integer linear programming model. The findings of this study will be reported.

4 - Cyclic Facility Layout Problem
Sadan Kulturel-Konak, Professor of Management Information System, Pennsylvania State University, Tulpehocken Rd., PO Box 7009, Reading, PA, 19610, United States of America, sadan@psu.edu, Abdullah Konak

Cyclic Facility Layout Problem (CFLP) is a special case of Dynamic Facility Layout Problem (DFLP) where there are several production periods and the production cycle repeats itself by going to the first period after the last period because of the seasonal nature of product type and demands. In this study, a large scale hybrid simulated annealing (LS-HSA) approach is proposed to solve the CFLP. Results show that the proposed LS-HSA approach is effective.

■ SB54

Level 1 -103A

Market-based Instruments for Congestion Mitigation: I

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Yafeng Yin, Associate Professor, University of Florida, 365 Weil Hall, Gainesville, FL, 32611, United States of America, yafeng@ce.ufl.edu

1 - An Outer Approximation Algorithm for the Robust Shortest Path Problem
Mehrdad Shahabi, PhD Student, West Virginia University, 1227 Pineview Dr, Morgantown WV, 26505, United States of America, mehrdad.shahabi@gmail.com, Avinash Unnikrishnan

The mean standard deviation shortest path problem is reformulated as a conic quadratic program, and an outer-approximation algorithm based algorithm is developed. Numerical experiments show that the outer-approximation algorithm significantly outperforms standard integer programming algorithms. Preliminary results are shown demonstrating the efficiency of this algorithm for the mean variance case.

2 - Autonomous Vehicles and Intersection Auctions: Efficiency and Equity
Stephen Boyles, Assistant Professor, The University of Texas at Austin, 301 E Dean Keeton St., Stop C1761, Austin, TX, 78712, United States of America, sboyles@mail.utexas.edu, Michael Levin, Dustin Carlino, Peter Stone

Autonomous vehicles admit new mechanisms for managing intersections and pricing travel choices, including decentralized auction-based intersection control. Simulation experiments are used to explore the relationships between total travel time, travel time impacts by value of time, and equity among travelers with different willingness to pay, as auction parameters are varied.

3 - Real-time Pricing of Managed Lanes with Refund Option
Yingyan Lou, Assistant Professor, Arizona State University, PO Box 875306, Tempe, AZ, 85287, United States of America, yingyan.lou@asu.edu, Abhay Lidbe

To improve travelers' experiences with managed lanes (ML), this study explores an innovative solution by introducing a refund option. Part of the toll paid by a traveler will be refunded if the travel time saving does not reach a certain minimal amount guaranteed. The goal of this pricing scheme is to achieve the operational objectives of MLs, including desired facility level of service and revenue return that can cover refund claims, and at the same time make MLs more appealing to travelers.

4 - An Efficient Solution Approach for the Bottleneck Model with General Heterogeneity
Yu Nie, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60608, United States of America, y-nie@northwestern.edu, Yang Liu

This paper proposes a semi-analytical approach that transforms the dynamic equilibrium problem of a bottleneck with heterogeneous users into a static and asymmetric traffic assignment problem, which is subsequently formulated as a variational inequality problem (VIP) and solved by a gradient projection algorithm. The uniqueness of the solution for the linear VIP with equality constraints is discussed.

■ SB55

Level 1 -103B

Transit, Pedestrians and Other Alternative Modes in Evacuation

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Hong Zheng, University of Arizona, Tucson, AZ United States of America, hzheng@email.arizona.edu

1 - Simulating Pedestrian and Vehicle Evacuation at Large Events
Zhuoyang Zhou, Research Assistant, Arizona State University, 699 S. Mill Ave., TA/RA Mail Room, Tempe, AZ, 85281, United States of America, zhuoyang.zhou@asu.edu, Hong Zheng, Pitu Mirchandani, Ning Wang

Currently, most evacuation management studies focus on vehicular traffic where their departure curves are assumed to be some analytical functions. This research developed a simulation model that included pedestrian evacuation process along with a proposed parking strategy to improve the evacuation efficiency. Performance comparison shows improved clearance time to safe boundaries.

2 - Supporting Special-needs Populations in Evacuation
Lei Feng, University of Maryland, 1173 Glenn L. Martin Hall, University of Maryland, College Park, MD, 20742, United States of America, lfeng@umd.edu, Elise Miller-Hooks

In this work, the use of paratransit fleets in the movement of persons with special needs to select shelter locations in a full-scale evacuation of a large urban area is considered. A mathematical model that seeks the optimal location of shelters along with the assignment of passengers to ridesharing vehicles and vehicles to tours is presented. A heuristic is presented for its solution. The solution method is illustrated on a real-world case study.

3 - A MIP Model for Strategic Evacuation Planning with Pedestrian Guidance and Bus Routing
Mojtaba Heydar, Department of Industrial and Manufacturing Engineering, University of Wisconsin-Milwaukee, PO Box 784, Milwaukee, WI, 53211, United States of America, mheydar@uwm.edu, Yue Liu, Matthew Petering

We present a MIP for strategic emergency planning in an urban area where a large number of pedestrians depend on buses for evacuation. The model (1) guides evacuees through a "pedestrian network" of streets and crosswalks to designated pick-up points and (2) routes a fleet of buses on a "vehicular network" from depots to pick-up points in order to transport evacuees to shelter areas. A heuristic method is developed to solve large-scale problem instances in a reasonable amount of time.

4 - An Efficient Evacuation Strategy for a High-rise Building Evacuation of Heterogeneous Population
Byung-In Kim, Associate Professor, POhang University of Science and Technology (POSTECH), Hyoja-Dong, Pohang, Korea, Republic of, bkim@postech.ac.kr, Jeongin Koo, Yong Seog Kim

Evacuating a heterogeneous population consisting of residents with various mobility limitations and space requirements take a much longer time than a homogeneous population because of the blocking effect of slowly moving people. This study proposes a dedicated route selection strategy for an effective evacuation in a 24-story building and optimally solve it via a time-expanded network flow model. Simulation experimental results confirm the effectiveness of the proposed strategy.

■ SB56

Level 1 -103C

Stochastic Control and Optimization in Energy Systems

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Xiaoxuan Zhang, IBM Watson Research, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, zhangxia@us.ibm.com

1 - Voltage and Reactive Power Control using Approximate Stochastic Annealing
Eugene Feinberg, Stony Brook University, Department of Applied Mathematics, Stony Brook, NY, United States of America, eugene.feinberg@stonybrook.edu, Jiaqiao Hu, Eting Yuan

This talk discusses voltage and reactive power control for distribution networks. We propose to use an approximate stochastic annealing (ASA) algorithm for solving the voltage and reactive power control problem to minimize energy losses. Our testing results indicate that the ASA algorithm yields within a modest amount of computational time near-optimal solutions.

2 - SMART-ISO: An Informationally Correct Model of the PJM Energy Markets and Power Grid

Warren Powell, Director, PENSA Laboratory, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, powell@princeton.edu, Hugo Simão, Boris Defourny

SMART-ISO is a detailed model of day-ahead, hour-ahead and real-time electricity markets, which carefully models the flow of information, as well as notification times and ramp rates of generators. We will report on model calibration, and the design of best-deterministic lookahead policies for robustness, as well as value function approximations for hydro storage. Finally we will report on the results of a study of high-penetrations of off-shore wind.

3 - Building Energy Analytics for Operational Energy Efficiency Improvement of Commercial Buildings

Young Lee, Manager, Process and Energy Analytics, IBM Research, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, ymlee@us.ibm.com, Lianjun An, Young Tae Chae, Raya Horesh, Rui Zhang

Analytics can play an important role in identifying energy saving opportunities in buildings by modeling and analyzing how energy is consumed in buildings. A set of analytics which can assist building operators in determining energy efficient operational settings of buildings through forecasting, simulation and optimization is presented.

4 - Stochastic Control for Smart Grid Users with Flexible Demand

Long He, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, CA, United States of America, longhe@berkeley.edu, Yong Liang, Xinyu Cao, Z. Max Shen

We study the optimal control problem for the demand-side of the Smart Grid under time-varying prices with general structures. We assume that users are equipped with smart appliances that allow delay in satisfying demands, and one central controller that makes energy usage decisions on when and how to satisfy the scheduled demands. We formulate a dynamic programming model for the control problem. We also propose an approximation approach based on Q-learning and a decentralization-based heuristic.

■ SB57

Level 1 -103D

Uncertainty and Market Equilibria in Energy Markets

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Carlos Ruiz, Chair on Systems Science and the Energetic Challenge, European Foundation for New Energy - Électricité de France, Plateau de Moulon, 3 Rue Joliot-Curie, F-91192 Gif-sur-Yvette, France, carlosruizmora@gmail.com

1 - Decision Rules in Power Systems Operation and Planning

Daniel Kuhn, Imperial College London, 180 Queen's Gate, London, SW7 2AZ, United Kingdom, d.kuhn@imperial.ac.uk

Many decision problems in power systems operation and planning are naturally formulated as optimization models with the following key attributes. They are high-dimensional, uncertainty-affected and dynamic. As such, they are not susceptible to classical dynamic or stochastic programming techniques. In this talk we discuss how such problems can be addressed with decision rule methods that have recently been popularized in robust optimization.

2 - Dynamics of Renewable Identification Numbers used for Compliance with the Renewable Fuel Standard

Adam Christensen, Postdoctoral Fellow, Johns Hopkins University, 3400 N Charles St., Ames Hall 313, Baltimore, MD, 21218, United States of America, adam.christensen@jhu.edu, Sauleh Siddiqui

Renewable Identification Numbers (RINs) are used to track the use of biofuels in the US transportation infrastructure and are the primary currency to demonstrate compliance with the mandated biofuel volume requirements. The RIN market and its respective players will be modeled using an equilibrium problem, which will be used to quantify the effects of parallel incentives in the form of tax credits and other policy initiatives.

3 - Analysis of the Relationship between Forward and Spot Contracts in Electricity Markets

Fernando Oliveira, Professor, ESSEC Business School, 100 Victoria Street, Singapore, Singapore, oliveira@essec.fr, Nalan Gulpinar

In this paper, we model the interaction between spot and forward trading under uncertain market conditions. The equilibrium of the multi-player dynamic games is derived. We analyze the impact of risk aversion and market structure on the forwards and spot pricing, trading and production in electricity markets.

4 - Supply Chain Coordination under Uncertainty in the Electricity Industry

Carlos Ruiz Mora, University Carlos III de Madrid, Avda. de la Universidad, 30, Leganés, Spain, caruizm@est-econ.uc3m.es, Fernando Oliveira

We propose a game-theoretical model to analyze the behavior and efficiency of the supply chain in electricity markets. We consider multiple generators and retailers that interact at different trading floors of the market and that simultaneously seek to maximize their respective profits. To this end, each agent anticipates the potential equilibria of the subsequent markets as well as the uncertainties associated to the final consumer's behavior and the generation production costs.

■ SB58

Level 1 -103E

Wildfire Management 1: Forecasting, Detection, and Initial Attack

Sponsor: Energy, Natural Res & the Environment/ Forestry/Mining

Sponsored Session

Chair: Matthew Thompson, Research Forester, US Forest Service, PO Box 7669, Missoula, MT, 59807, United States of America, mpthompson02@fs.fed.us

1 - Developing Forecasting Tools for Arson and Other Kinds of Human-caused Fires on Tribal Lands

Jeffrey P. Prestemon, USDA Forest Service, RTP, NC, United States of America, jprestemon@fs.fed.us, David T. Butry, Douglas Thomas, Sam Scranton

Alternative statistical time series forecast models of human-ignited wildfires on tribal lands of the United States indicate that arson and some human-caused fires are forecastable using Autoregressive Conditional Poisson (ACP) models (Heinen and Rengifo 2003). In out-of-sample data conditions, these models outperform plausible forecast model alternatives, including a naÔve random walk and those based on crime hotspotting tools (e.g., CompStat). ACP models could be used to aid in tactical responses to wildfire outbreaks by law enforcement and firefighting organizations. We report model specifications at the weekly time step for individual tribal land units. Exogenous predictors include the most recent weeks' counts of fires, seasonality, and weather variables. Such simple specifications facilitate their implementation because of their low data demands, while the weekly time step provides time for resource reallocations.

2 - The Development and Use of Forest Fire Detection Probabilities for Detection Patrol Route Planning

David Martell, University of Toronto, Faculty of Forestry, Toronto, ON, Canada, david.martell@utoronto.ca, Robin Santiago, Douglas Woolford, Colin McFayden, Mike Wotton

Forest and wildland fire managers seek to find fires while they are small to increase the chance that should a fire pose a threat, it will be contained by the initial attack system while still small, to minimize its destructive impact. We describe how we combined real-time GPS aircraft tracking data and the estimated ignition times of lightning-caused forest fires to estimate fire detection probabilities and how those detection probabilities can be used to help route aerial detection patrols.

3 - A Probabilistically Constrained Model for Wildfire Initial Response Planning

Julian Gallego, Texas A&M University, Austin, TX, United States of America, kamizama77@tamu.edu, Lewis Ntaimo, Curt Stripling

We present a probabilistically constrained stochastic integer program model for wildfire initial response planning that incorporates both wildfire risk and the decision-maker's risk averseness. The model uses wildfire risk indices based on the Texas Wildfire Risk Assessment system. We report on the application of the model to one of the Texas A&M Forest Service fire planning units in East Texas.

4 - Initial Attack Dispatching Configurations: Standard Responses vs. Perfect Knowledge Solutions

Yu Wei, Colorado State University, Boulder, CO, United States of America, wei@cnr.colostate.edu, Erin Belval

A series of complex decisions need to be made at a dispatch center upon the occurrence of one or more fires. Pre-designed standard response rules help shorten response reaction time by providing intuitive dispatch guidelines based on fire weather, ignition locations and local experience. Stochastic optimization models provide a systematic and consistent way to evaluate existing standard response rules, compare it with perfect knowledge solutions, or to generate new and more efficient rules under possible fire scenarios. This study explores new knowledge in designing and implementing initial attack response rules.

■ SB59

Level 1 -103F

Biomass Supply Chain Modeling and Analysis

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Taraneh Sowlati, Associate Professor, University of British Columbia, 2931 - 2424 Main Mall, Vancouver, BC, V6T1Z4, Canada, taraneh.sowlati@ubc.ca

1 - Evaluating the Impact of Uncertainty on the Value Chain Optimization of a Forest Biomass Power Plan

Nazanin Shabani, University of British Columbia, Vancouver, BC, Canada, nazanin.shaebani@gmail.com, Taraneh Sowlati

In this paper Monte Carlo simulation is used to assess the impact of uncertainties in biomass availability and cost, moisture content (MC), higher heating value (HHV) and electricity price on the profit of a biomass power plant. The deterministic optimization model considers biomass procurement, storage, electricity production and ash management. It is a mixed integer non-linear model with monthly time-steps over a one-year time horizon.

2 - Simulation of Forest Biomass to Bio-fuel and Bioenergy Supply Chains

Mahdi Mobini, PhD Candidate, The University of British Columbia, #2943 - 2424 Main Mall, Vancouver, BC, V6T1Z4, Canada, mahdi.mobini@gmail.com, Taraneh Sowlati

Stochastic discrete-event simulation models are developed to analyze the performance of the supply chain of forest-based biomass to wood pellets (solid biofuel) and combined heat and power. The models take into account the uncertainties in the quality of raw materials and interdependencies between different stages of the supply chain.

3 - An Optimization Model for Advanced Biofuel Production Based on Bio-oil Gasification

Qi Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, qili@iastate.edu, Guiping Hu

In this research, a two-stage stochastic programming is formulated. The first-stage makes the capital investment decisions including the locations and capacities of the bio-facilities (distributed small scale fast pyrolysis plants and centralized refining facility) while the second-stage determines the biomass and bio-fuels flows. This paper aims to find the optimal design of the supply chain considering uncertainties in biomass yield, biofuel price and transportation costs.

4 - Heuristic Optimization of Biofuels Production Scenarios That Meet U.S. Renewable Fuel Standards

David Johnson, RAND Corporation, 1776 Main St., PO Box 2138, Santa Monica, CA, 90407, United States of America, djohnson@rand.org

The U.S. Renewable Fuel Standard specifies that 36 billion gallons of liquid fuels from renewable sources be used annually by 2022. Its success in reducing greenhouse gas emissions depends upon many factors determining the life cycle emissions of biofuels. Using the Calculating Uncertainty in Biomass Emissions model, we present production scenarios that maximize emissions reductions and discuss how the efficient frontier changes when considering multiple criteria like land use change.

■ SB60

Mezzanine - 100A

2013 INFORMS Data Mining Best Student Paper Competition

Sponsor: Data Mining

Sponsored Session

Chair: Chun-An (Joe) Chou, SUNY Binghamton, Binghamton, NY, 13902, United States of America, cachou@binghamton.edu

1 - A Spatio-Temporal Mixture Model for Point Processes with Application to Ambulance Demand

Zhengyi Zhou, Cornell University, Ithaca, NY, United States of America, zz254@cornell.edu

2 - Flow Modeling and Prediction of Heterogeneous Patients using Semi-Markov Mixture Clustering

Chitta Ranjan, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, nk.chitta.ranjan@gatech.edu, Kamran Paynabar, Jonathan Helm

3 - An Interpretable Stroke Prediction Model using Rules and Bayesian Analysis

Ben Letham, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, bletham@mit.edu

4 - An Inexact Homotopy Method for Nonconvex High Dimensional Sparse Learning Problems

Zhaoran Wang, Princeton University, Princeton, NJ, United States of America, zhaoran@Princeton.edu

■ SB61

Mezzanine - 100B

Data Analytics and Modeling for Healthcare Management I

Sponsor: Data Mining

Sponsored Session

Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, Woolf Hall 420H, 500 West First Street, Arlington, TX, 76019, United States of America, shouyisxty@gmail.com

1 - Outcome and State Transition Modeling for Adaptive Interdisciplinary Pain Management

Aera Leboulluec, University of Texas at Arlington, Dept. of Indus. & Manufac. Sys. Engr., Arlington, TX, 76019, United States of America, aerakim77@yahoo.com, Victoria C. Chen, Li Zeng

Pain management is a global health problem costing $600 billion in the U.S. alone. UTA and UTSW are seeking adaptive treatment strategies for interdisciplinary pain management. Our framework employs approximate dynamic programming with state transition and outcome models estimated from actual patient data. This research develops a process based on the inverse-probability-of-treatment weighted method to address endogeneity while estimating state transition and outcome models.

2 - Enhancing Clinical Utility of Respiratory-gated PET/CT Imaging using Patient Classification

Shouyi Wang, Assistant Professor, University of Texas at Arlington, Woolf Hall 420H, 500 West First Street, Arlington, TX, 76019, United States of America, shouyisxty@gmail.com, Art Chaovalitwongse

A respiratory-gated (RG) method allows patients with lung tumors to breathe normally in PET/CT scan while minimizing respiratory motion effects. However, not all patients can benefit from the RG method. We constructed a prediction model to predict the effectiveness of the RG method on each individual patient only using features extracted from respiratory motion traces. The technique can be used to classify patient groups and assign the most appropriate strategy for each patient in PET/CT scan.

3 - Predicting All-cause 30-day Patient Readmission

Issac Shams, Research Assistant, Wayne State University, 4815 4th Street, Detroit, MI, 48201, United States of America, er7671@wayne.edu, Kai Yang, Saeede Ajorlou

Based on the literature of risk prediction models, patient's socioeconomic and diagnosis factors are related to the risk of readmission.In this paper we propose two patient-specific classification methods1)A multi-level logistic random regression and2)A bootstrapped random forest that can perform sampling at the patient level. We validate and compare our proposals with a large inpatient data set from four VA facilities in the state of Michigan.

■ SB62

Mezzanine - 100C

IIE Transactions Invited Session

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jianjun Shi, Industrial and Systems Engineering, Georgia Institute of Technology, 765 Ferst Drive, Room 109, Atlanta, United States of America, jianjun.shi@isye.gatech.edu

1 - Reliability of Sensors Based on Nanowire Networks

Kristin McCullough, Grand View University, Des Moines, IA, 50316, United States of America, kmccullo4@gmail.com, Nader Ebrahimi, Zhili Xiao

Advances in nanotechnology have enhanced the performance of sensors. In this talk we focus on the reliability of a Palladium nanowire network based hydrogen sensor. We use a square lattice to model the structure and assume the sensor is operating in an environment where the probability of a wire breaking changes after hydrogen exposure. We also consider the case where the probability does not change. The results are applicable to any nanodevice where the proposed model is a reasonable choice.

2 - A Transfer Learning Approach for Network Modeling

Shuai Huang, Assistant Professor, University of South Florida, 4202 E Fowler Ave., ENC 2509, Tampa, 33620, United States of America, shuaihuang@usf.edu, Jing Li

Network models have been widely used in many subject areas to characterize the interactions between physical entities. A typical problem is to identify the network for multiple related tasks. We proposed a transfer learning approach that can leverage the knowledge gained during the modeling of one task to help better model another task, by adopting a Bayesian hierarchical model framework and L1-regularization. We used this model for biomarker discovery for Alzheimer's disease from fMRI data.

3 - Fractals-based Statistical Process Control (SPC)

Irad Ben-Gal, Tel-Aviv University, Tel Aviv, Israel, bengal@eng.tau.ac.il, Noa Ruschin Rimini, Oded Maimon

In recent years, with the overall increase in data availability there is a growing need for new monitoring techniques that can cope with such data complexity. For this purpose, we suggest a new statistical process control (SPC) approach for data-rich environments. The proposed approach is based on the theory of fractal geometry.The fractal model can be used for anomaly detection, pattern analysis and knowledge discovery.

■ SB63

Mezzanine - 100D

Decision Analysis Approaches and Predictive Modeling to Managing Uncertainty in Manufacturing and Service Systems Design & Operations

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Zhenyu (James) Kong, Associate Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, james.kong@okstate.edu

1 - Time Series Forecasting for Nonlinear and Nonstationary Systems: A Comparative Study

Changqing Cheng, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74074, United States of America, changqing.cheng@okstate.edu, Trung Le, Satish Bukkapatnam, Hui Yang, Zhenyu (James) Kong

Complex systems usually demonstrate nonlinear and nonstationary dynamics. Time series data from those systems can represent casual and dynamic information about the underlying dynamics, and provide a unique way to monitor the system state evolution. We reviewed the recently developed models for nonlinear nonstationary time series prediction, and provided a comparative study.

2 - Process Monitoring of Ultra Precision Machining (UPM) using Evidence Theory Based Sensor Fusion

Omer Beyca, Ph.D. Student/Research Associate, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74074, United States of America, omer.beyca@okstate.edu, Zhenyu (James) Kong, Satish Bukkapatnam

Surface integrity is vital for Ultra Precision Machining (UPM) processes. Therefore monitoring the UPM process is crucial to detect the process anomalies at their early stages, and thus, to improve surface integrity. In this study we developed a Dirichlet process based sensor fusion method for UPM process monitoring. The case study demonstrated its effectiveness in capturing process variability in the UPM.

3 - Demand Forecasting in Service Industries

Kin Ming Kam, Graduate student, The University of Texas at Arlington, 500 West First Street, Arlington, TX, 76019, United States of America, kinming.kam@mavs.uta.edu, Li Zeng

Demand forecasting is a critical problem in service planning and management. This study develops a Bayesian dynamic modeling approach for demand forecasting and compares it to the popular ARIMA modeling methods using data from transportation and healthcare services.

■ SB64

Mezzanine - 100E

Joint Session QSR/DM: Panel Discussion: Funding Opportunities

Sponsor: Quality, Statistics and Reliability & Data Mining

Sponsored Session

Moderator: Hui Yang, Assistant Professor, University of South Florida, 4202 E Fowler Ave. ENB118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Joint Session QSR/DM: Panel Discussion: Funding Opportunities

Moderator: Hui Yang, Assistant Professor, University of South Florida, 4202 E Fowler Ave. ENB118, Tampa, FL, 33620, United States of America, huiyang@usf.edu, Panelists: Edwin Romeijn, Eva Lee

In this panel, program officers and study section members from NSF and NIH will talk about funding opportunities. The panelists are: Dr. Edwin Romeijn from NSF SES&MES&SCH; Dr. Eva Lee from NIH Biodata Management and Analysis Study Section [BDMA].

■ SB65

Mezzanine - 100F

Social Media Analytics and Crisis Informatics

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Hyun-Woo Kim, PhD Candidate / Graduate Teaching Fellow, Pennsylvania State University, 324 IST Building, University Park, PA, 16802, United States of America, hxk263@ist.psu.edu

1 - Mining Social Media to Predict China Stock Market

Yibo Chen, City University of Hong Kong, Department of Management Sciences, Hong Kong, Hong Kong - PRC, chenyibo@cityu.edu.hk, Tao Yan, Wenbin Zhu, Andrew Lim

We employ text mining tools and statistical models to forecast China stock market movement based on collective online viewpoints of individual investors. We quantify the collective viewpoints by analyzing and aggregating their online posts related to the stock market, where the main challenge lies in the Chinese semantic analysis. Our statistical results suggest that there exists a strong causality relation between the collective viewpoints from Sina micro blog and China stock market movement.

2 - PhaseVis: Analyzing and Visualizing Disaster Tweet Messages

Seungwon Yang, Virginia Tech, 1060 Red Leaf Ct., Christiansburg, VA, 24073, United States of America, seungwon@vt.edu, Sunshin Lee, Xiao Lin, Liangzhe Chen, Haeyong Chung, Andrew Wood

PhaseVis is a tool, which can visualize multiple aspects of disaster tweet datasets, namely the What, When, Where, and Who aspects. Prior to visualization, tweets are classified using machine learning approach. Different categories might be used, for example, the four phases of emergency management (i.e., response, recovery, mitigation, and preparedness) or sentiments. Our vision is to apply PhaseVis in different informatics domains such as health, business as well as disaster.

3 - Identifying Social Media Users Who Refuse to Evacuate in the Context of Forecasted Natural Disasters

Hyun-Woo Kim, PhD Candidate / Graduate Teaching Fellow, Pennsylvania State University, 324 IST Building, University Park, PA, 16802, United States of America, hxk263@ist.psu.edu, Andrea Tapia, John Yen

Natural disasters like Superstorm Sandy mobilize people even before they hit certain areas. There are people who refuse to evaluate when they must due to insufficient information on forecasted threats. In this paper, we analyze Twitter data on Sandy and propose an approach to identify those people who are not willing to evacuate based on their postings on Twitter so local emergency management officials can keep their eyes on them when situations get worse.

4 - The Network Community Structure Detection Problem

Jiaofei Zhong, Assistant Professor, University of Central Missouri, W.C. Morris Building, Room 222, Warrensburg, MO, 64093, United States of America, zhong@ucmo.edu, Zaixin Lu, Weili Wu, Zheng Gao, Weidong Chen, Yuanjun Bi

Many network systems of interest are rising from the real world, e.g. social networks. One typical issue is to find the community structures. We propose a community structure detection problem which aims to analyze the relationships among data via the network topology. We collect a series of unified definitions for community structures and formulate the community detection into an optimization problem to identify as many communities as possible, and develop a heuristic algorithm for it.

■ SB66

Mezzanine - 100G

Information Systems and Operation Management

Sponsor: Information Systems

Sponsored Session

Chair: Dengpan Liu, Assistant Professor, Iowa State University, College of Business, Ames, IA, 50011, United States of America, dliu@iastate.edu

1 - Competitive Product Design in Computer-based Industries

Kunpeng Li, Assistant Professor, Utah State University, Jon Huntsman School of Business, Logan, UT, 84322, United States of America, likunpeng@hotmail.com, Dilip Chhajed, Suman Mallik

A product consists of a software and a hardware. We study product quality and variety design in a duopoly.

2 - Research on CPV(Cost Per View) Online Advertising Pricing Model

Haifei Yu, Northeastern Unversity, Shenyang, 110819, China, hfyu@mail.neu.edu.cn, Shoufeng Ji

For CPM pricing model is unable to identify the browsing quality of online advertisements, a novel CPV pricing model is supposed, which is based on the exposure time of advertisements. MATLAB simulation and analysis of factors that influence the advertiser's and publisher's model (CPV or CPM) preference are performed. The three factors are orderly ranked by their influence power on the model preference as the browsing time mean, variance, and the browsing quality standard.

3 - Web Services Adaptation in the Presence of Business Protocol Evolution

Maryam Eslamichalandar, PhD Candidate, Conservatoire National des Arts et Métiers (CNAM), Cédric - Groupe Vespa, 2 Rue Conté, Paris, 75141, France, mechalandar@gmail.com, Hamid Reza Motahari-Nezhad, Kamel Barkaoui

A fundamental challenge in interoperability of heterogeneous Web services is compatibility. In the context of Web service interaction via adapters, it is significant to cope with potential impacts of the evolution of service business protocol on the adapter. We propose an approach to automatically identify the impacts of changes and to dynamically update the adapter. Besides, experimental results of a prototype tool show the benefits of approach compared to static adapter regeneration methods.

4 - Retailer's Multichannel Strategies under Random Yield and Demand Uncertainty

Weijun Yang, Xi'an Jiaotong University, School of Management, No. 28 Xianning West Road, Xi'an, 710049, China, ywj0126@126.com, Shulin Liu

Consider a supply chain that consists of one supplier with random yield and one retailer with demand uncertainty. This paper is motivated from the widely use of Online To Offline (OTO) business model in electronic commerce. We focus in this paper on the case that the retailer with yield and demand uncertainty to make channel strategy choice. Two major questions are addressed. When should a retailer adopt a multichannel strategy? What is the impact of multichannel on price and profit problems?

5. RFID Facilitated Information Sharing in Supply Chain Management

Qiannong Gu, Assistant Professor, Ball State University, Muncie IN, United States of America, qgu@bsu.edu

RFID technology offers advanced information sharing. This research explores opportunities and challenges of real-time RFID information sharing in supply chain management.

■ SB67

Mezzanine - 100H

Behavioral Economics and Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Ying He, PhD Candidate, The University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, ying.he@phd.mccombs.utexas.edu

1 - The Satiation Model

Manuel Baucells, Professor, Rand Corporation, 1776 Main St., Santa Monica, CA, 90407, United States of America, mbaucells@gmail.com

The standard discounted utility model defined over arbitrary time intervals suffers from a major inadequacy: lack of continuity in the space of consumption. A general condition is known to restore continuity, but it has not been sufficiently explored to produce a model with convincing economic properties. We remedy this situation by proposing a model that incorporates satiation. We explore the optimal solutions, which involve both consumption rates (sips) and discrete consumption gulps.

2 - Time Consistency in Collective Decisions

Enrico Diecidue, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Enrico.DIECIDUE@insead.edu

We propose new evidence on the outcomes achieved by collective and individual decisions over time. We combine static and longitudinal methods to test four conditions on time preferences: impatience, stationarity, age independence and dynamic consistency. Results: Individuals were impatient and deviated from consistent behavior. On the contrary, groups took patient and highly consistent decisions. The voting mechanism helped groups to converge to dynamically consistent decisions.

3 - Hope, Dread, Disappointment, and Elation from Anticipation in Decision Making

Ying He, PhD Candidate, The University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, ying.he@phd.mccombs.utexas.edu, John Butler, James Dyer

We propose a model to incorporate both anticipation and disappointment into decision making, which captures the trade-off between a utility gain from higher anticipation and a utility loss from higher disappointment. The model is used to explore how optimistic attitude could mediate the wealth effect on risk attitude. We show that our model can explain the coexistence of a demand for gambling and insurance and provides unique insights into portfolio choice and advertising decision problems.

4 - A Model of Mental Accounting and Reference Price Adaptation

Woonam Hwang, PhD Candidate, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, whwang.phd2009@london.edu, Manuel Baucells

We propose a modification of discounted utility that incorporates a process of mental accounting. Consumers hold reference prices in mind, which they use to calculate the book value at which items enter and exit the mental account. Reference prices are endogenously determined. The model explains a wide array of observed anomalies such as reluctance to trading, sunk-cost effects, payment depreciation, preference for pre-payment, and the flat-rate bias. We compare our model with existing models.

■ SB68

Mezzanine - 100I

What is New in ODQ? (Organizational Decision Quality)

Sponsor: Decision Analysis

Sponsored Session

Chair: Carl Spetzler, CEO, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

1 - What is New in Organizational Decision Quality

Carl Spetzler, CEO, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

The adoption of Decision Quality as a deep organizational core competence is accelerating. Other oil companies are following Chevron's lead; Pharma adoption is moving beyond the traditional development portfolio decisions; Major technology companies are building capabilities; and we see many job openings for decision professionals. The key to adoption is to reach the tipping point of "converts" among the top management in an enterprise. We'll share stories and lessons learned.

2 - Making Decision Analysis Routine in Organizations

Onder Guven, PhD Candidate, Stanford University, Stanford, CA, 94305, United States of America, onderguven@stanford.edu

Most organizations utilize decision analysis as one-off interventions. By utilizing interviews and surveys with decision makers in institutional settings, along with the organizational behavior literature, this research aims to develop a decision analytic framework that can incorporate decision analysis into routine business practices.

3 - Pairing Decision Analysis and Analytics at Chevron

Larry Neal, Chevron, 6001 Bollinger Cyn Rd., San Ramon, CA, 94583, United States of America, LarryNeal@chevron.com, Margery Connor

Major Capital Projects in the oil and gas industry are reaching extraordinary levels of size and complexity. Complexity in particular presents challenges modeling the investment alternatives in a manner consistent with good decision quality. Chevron's DA Community partners with our Analytics CoE to overcome these analytical barriers, incorporating discrete event simulation and other techniques to simplify the economic modeling yet maintain a high degree of transparency and decision quality.

■ SB69

Mezzanine - 100J

Sustainable Infrastructure Modeling

Sponsor: Decision Analysis

Sponsored Session

Chair: Hakob Avetisyan, University of Maryland, College Park, Department of Civil and Environmental, College Park, MD, 20742, United States of America, havetisy@umd.edu

1 - A Hybrid Model for Sustaining Long Term Infrastructure Projects

Deepak Sharma, Visiting Assistant Professor, University of Baltimore, 1420 N Charles Street, Baltimore, MD, 21201, United States of America, dsharma@ubalt.edu

Many clauses in long term projects are designed using traditional methods which could be inadequate to sustain the impacts of uncertainties. This work presents a hybrid model that can design clauses for sustaining construction contracts. The model integrates multi-objective linear programming model with stochastic dynamic programming model. The model incorporates uncertainty, multiple objectives and sustainable provisions. A case study is included as a means to demonstrate the use of the model.

2 - A Mixed-integer Programming Tool for Creating Effective Schematic Urban Transit Maps

Olufolajimi Oke, Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD, 21218, United States of America, ooke1@jhu.edu, Sauleh Siddiqui

Schematic maps underpin sustainable urban transit networks. Effective maps facilitate user navigation by balancing topographical representation and accessibility. We have built upon recent schematic map automation efforts by developing an improved mathematical model and computational enhancements to create a versatile drawing tool for better interactions across a variety of systems.

3 - Sustainable Infrastructure Modeling and Policy Analyses

Hakob Avetisyan, University of Maryland, College Park, Department of Civil and Environmental, College Park, MD, 20742, United States of America, havetisy@umd.edu

Sustainable infrastructure operation assumes consideration of interrelated elements and problems within interacting industries in which the decisions made for one industry may affect those in related industries. Therefore, it is vital to analyze the problem in a systematic fashion to find cost-efficient, technically well-designed and constructed sustainable solutions. A set of models was developed to allow such analysis for considering the deterministic cases followed by probabilistic versions.

■ SB70

Mezzanine -101A

Ticket Pricing and Revenue Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Raha Akhavan-Tabatabaei, Assistant Professor, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, Colombia, r.akhavan@uniandes.edu.co

1 - Investigating Airline Customers' Premium Coach Seat Purchases and Implications for Optimal Pricing

Laurie Garrow, Georgia Institute of Technology, 790 Atlantic Drive, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu, Stacey Mumbower, Jeffrey Newman

We investigate airline customers' purchases of premium coach seats using online data from JetBlue's website. Behavior is influenced by the amount of the seat fee, how far in advance the ticket is purchased, the number of passengers traveling together, and load factors. Customers are between 2 and 3.3 times more likely to purchase premium coach seats when there are no window or aisle seats that can be reserved for free.

2 - Managing Switching Behavior with Presence of Price Tracking Customers

Fouad H. Mirzaei, Ivey Business School, Western University, London, ON, N6G4X3, Canada, fhm.phd@ivey.ca, Fredrik Odegaard, Xinghao Yan

Many airlines permit passengers to change a purchased ticket for another flight by paying a penalty. This switching penalty is a revenue item for the airline, however a high fee could increase the risk of lost sales. The question that arises is how much penalty should be set for switching, knowing that the magnitude of switching fee impacts on switching behaviour of ticket holders. We model a single firm, which triggers customers' switching behavior by markdown pricing policy.

3 - A Stochastic Dynamic Model to Optimize the Promotions Period in Airlines

Daniel Felipe Otero Leon, Instructor, Universidad de los Andes, Cra 1 No 18a - 10 of ML-334, Bogota, Colombia, df.otero128@uniandes.edu.co, Raha Akhavan-Tabatabaei, Cristina López Garzón

Promotions help increment the demand for a flight. Several decisions have to be made to offer a promotion such as the price and when and for how long to offer it. The problem of fixing the price is extensively discussed, unlike the problem that given a fixed promotional price, when and for how long it should be offered. We propose a stochastic dynamic model to maximize the revenue, by evaluating the decision of whether or not to offer the promotion, taking into account the effects of dilution.

■ SB71

Mezzanine -101B

Application of OR in Airport Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Shokoufeh Mirzaei, Assistant Professor, California State Polytechnic University, 3801 W Temple Ave., Pomona, CA, 91768, United States of America, smirzaei@csupomona.edu

1 - Airport Congestion Management through Schedule Coordination: An Integrated Scheduling Approach

Alexandre Jacquillat, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-234a, Cambridge, MA, 02139, United States of America, alexjacq@mit.edu, Nikolaos Pyrgiotis, Amedeo Odoni

Congestion at capacity-constrained airports can be mitigated through schedule coordination. This paper examines how flight delays can be reduced while minimizing the impacts on airlines' networks of flights and passengers' itineraries. The approach combines stochastic queue dynamics, capacity estimation at the operational level and an Integer Programming scheduling model at the strategic level. It shows that delays can be significantly reduced with limited interference with existing schedules.

2 - TSA Pre-check Expansion (Capstone)

Florian Tafa, Southern Polytechnic State University, 1100 South Marietta Pkwy, Marietta, GA, 30060-2896, United States of America, ftafa11@gmail.com, Rubi Gutierrez

The purpose of this study is the design and simulation of the proposed locations of the TSA Pre-Check program in the Hartsfield-Jackson Atlanta International Airport. By simulating the proposed locations, we will then determine the ideal placement location for the new Pre-Check queues. This implementation will be affected by the results of this study as well as other factors concerning all stakeholders.

3 - Impact of Aircraft Arrival Processes on Airport Capacity and Delay

Abdullah Karaman, Assistant Professor, University of Turkish Aeronautical Association, Turkkusu Campus, Etimesgut, Ankara, 06790, Turkey, abdullahkaraman@yahoo.com

Modeling arrival traffic at an airport is a challenging task. Arrivals as wheels of the aircraft touching the landing field do not conform to randomness. This is because air traffic controllers start positioning the aircrafts in order so that the separation minima are satisfied. In this study, we investigate the impact of arrival processes on airport capacity and delay. We determined the cost of incorrectly specifying a distribution via simulation studies under both heavy and light traffic.

■ SB72

Mezzanine -101C

OR/MS in Economics

Contributed Session

Chair: Thomas Weber, Professor, Ecole Polytechnique Fédérale de Lausanne, EPFL-CDM-ODY 1.01B, Lausanne, CH-1015, Switzerland, thomas.weber@epfl.ch

1 - Estimating Real Money Balances for a Select Latin American Country: A Simultaneous Equation Model

Abul Jamal, Professor, Southeastern Louisiana University, College of Business, Hammond, LA, 70402, United States of America, ajamal@selu.edu, Yu Hsing

Equilibrium real balances and interest rates have been the subjects of extensive research. Most studies presume the supply of money to be determined by the central bank and the interest rate may be only affected by the demand for money. In this study we employ both money demand and supply functions to estimate real balances in a selected Latin American country.

2 - "Success Breeds Success" or "Pride Goes Before a Fall"? Teams and Individuals in Contests

Fangfang Tan, Senior Research Fellow, Max Planck Institute for Tax Law and Public Finance, 17414 NE 35PL, Redmond, WA, 98052, United States of America, tff626@gmail.com, Changxia Ke, Qiang Fu

We study the impact of feedback on subsequent performances in team contests in which team members work complementarily. In a three-round contest, our data corroborate the theoretical prediction for teams: neither winning nor losing the first round biases the contestants' performances competing in the second round. In individuals, we observe that, to the opposite of theory predictions, first-round winners perform worse, while first-round losers perform better if provided with feedback.

3 - Optimal Consumer Search on Multiple Products

Te Ke, UC Berkeley, 2521 Hearst Ave., Room 1117, Berkeley, CA, 94720, United States of America, kete@berkeley.edu, Miguel Villas-Boas, Z. Max Shen

Most consumers search multiple products and compare them before purchase. To understand their search behavior is critical to devise competitive pricing and promotion strategies. Information arrives random, and correlates among products. We model consumers' valuation as a Brownian motion. Search is costly. At any time, a consumer optimally chooses which product to search, or to purchase, or to leave without purchase. We solve our model analytically, and highlight a wide range of implications.

4 - On the (Non-)Equivalence of IRR and NPV

Thomas Weber, Professor, Ecole Polytechnique Fédérale de Lausanne, EPFL-CDM-ODY 1.01B, Lausanne, CH-1015, Switzerland, thomas.weber@epfl.ch

The internal rate of return (IRR) is generally considered inferior to net present value (NPV) for evaluating projects despite its inherent comparability to cost of capital and return of investment opportunities. We introduce the "selective IRR" as new investment criterion, which as a selection of an extended set of possible IRRs is equivalent to the NPV criterion. The selective IRR always exists, is unique, easy to compute, and does not suffer from drawbacks of the project investment rate.

Sunday, 1:30pm - 3:00pm

■ SC01

Level 2 - Room 200A

Portfolio Selection and Measurement of Risk

Cluster: Optimization in Finance

Invited Session

Chair: Michael Padilla, Assistant Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, michael_padilla@sutd.edu.sg

Co-Chair: Karthik Natarajan, Associate Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, natarajan_karthik@sutd.edu.sg

1 - A Practicable Framework for Distributional Robust Optimization with Application in Portfolio Selection

Meilin Zhang, Phd Candidate, NUS, 01-06, Biz2, NUS, Singapore, Singapore, 117592, Singapore, meilin.zhang@nus.edu.sg, Melvyn Sim

We propose a new framework for robust optimization under distributional ambiguity, which can be used in portfolio selection problems where the distributions of the underlying returns are not fully characterized. The ambiguity set is characterized by the projections of means and bounds on expectations of convex utility functions of the underlying uncertainties.

2 - Learning Risk Measures through Inverse Optimization

Vishal Gupta, Massachusetts Institute of Technology, ORC, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, vgupta1@mit.edu, Dimitris Bertsimas

Specifying risk preferences is critical in many applications. Descriptions, like "conservative" or "risky," are notoriously uninformative. We take a data-driven perspective. Using inverse optimization, we construct a coherent risk measure from an investor's historical holdings that approximately describes her behavior. We illustrate our approach with a case study of US mutual funds, clustering funds by their fitted risk profiles and contrast to traditional Lipper ratings.

3 - Performance-based Regularization in Mean-CVaR Portfolio Optimization

Gah-Yi Vahn, Assistant Professor, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, gvahn@london.edu

We propose a new regularization concept, performance-based regularization (PBR), to mean-CVaR portfolio optimization. We show via simulations that PBR substantially improves upon Sample Average Approximation in finite-sample performance for three different population models of stock returns. We also prove that PBR is asymptotically optimal and derive its first-order behavior by extending asymptotic analysis of M-estimators.

■ SC02

Level 2 - Room 200B

Multi–objective Optimization Insights from System Design Problems

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Liliana Shelton, Systems Analyst, Sandia National Laboratories, PO Box 5800-1188, Albuquerque, NM, 87185, United States of America, lshelto@sandia.gov

1 - Using Multi-objective Combinatorial Optimization to Inform New Military Vehicle Design

Liliana Shelton, Systems Analyst, Sandia National Laboratories, PO Box 5800-1188, Albuquerque, NM, 87185, United States of America, lshelto@sandia.gov

Given the stringent fiscal environment surrounding defense acquisition coupled with the need to maintain and improve military capabilities, it is extremely important to obtain greater efficiency in defense spending. To address this issue, we employ a Multi-Objective Combinatorial Optimization approach that meticulously explores multitudes of possible design decisions to map out the complex trade space that exists between requirement satisfaction, performance, cost, and schedule.

2 - Vehicle Trade Studies with Commonality

Stephen Henry, Systems Analyst, Sandia National Laboratories, PO Box 5800-1188, Albuquerque, NM, 87185, United States of America, smhenry@sandia.gov

When optimizing the design of new military vehicle platforms, it is often desirable to make certain components common across platform variants to reduce procurement and maintenance costs. However, the incorporation of commonality into trade space analyses brings some unique challenges. In this presentation we will examine various commonality analysis approaches, including a variety of commonality measures along with the advantages and disadvantages of integrated vs. post-hoc commonality.

3 - Sensitivity Analyses for Multi-objective Combinatorial Optimization Problems

Alexander Dessanti, Systems Analyst, Sandia National Laboratories, PO Box 5800-1188, Albuquerque, NM, 87185, United States of America, adessan@sandia.gov

Given the complex nature of multi-objective combinatorial optimization (MOCO) problems, it is important to determine where decision makers should focus their effort and resources. To address this issue, this study examines techniques for determining which input parameters in a MOCO problem have the greatest impact on the resulting optimal trade space. In this case, the trade space represents a set of optimal combat vehicle designs with respect to five dimensions of stakeholder value.

■ SC03

Level 2 - Room 200C

Recent Advances in (MI)NLP

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Claudia D'Ambrosio, Ecole Polytechnique, Palaiseau Cedex, 91128, France, dambrosio@lix.polytechnique.fr

1 - Recent Advances on the Solution of the DMDGP

Andrea Cassioli, Ecole Polytechnique, Route de Saclay, Palaiseau, 91128, France, cassioli@lix.polytechnique.fr, Leo Liberti, Antonio Mucherino, Carlile Lavor

The DMDGP is a subclass of the DDGP in which the pecularities of the geometric structure of molecule are exploited. The use of a discrete search algorithm, the interval Branch&Prune (iBP), allows to enumerate all the possible solution of the problem. We will present recent extensiona to the iBP framework: (1) the use of Clifford Algebra to improve the discretization of distances defined as continuous intervals; (2) the introduction of pruning devices specific for molecules.

2 - Mathematical Programming: Turing-completeness and Applications to Algorithmic Analysis

Leo Liberti, IBM Research, Yorktown Heights, NY, 10598, United States of America, leoliberti@gmail.com, Fabrizio Marinelli

We provide a new proof of the fact that Mathematical Programming is Turing-complete, and show how it can be useful in algorithmic analysis.

3 - Analysis of MILPs for the Pooling Problem

Akshay Gupte, Assistant Professor, Clemson University, Martin Hall, Dept. of Math Sciences, Clemson University, Clemson, SC, 29634, United States of America, agupte@clemson.edu, Santanu Dey

We analyze MILP relaxations and restrictions of the pooling problem, a NP-hard bilinear program. We first prove that the ratio of any piecewise linear relaxation value to the global optimal value is at most the number of output nodes N, and for any e > 0, there exists a instance where this ratio is at least N - e. Next, we design a MILP-based heuristic that is guaranteed to provide solutions within a factor of N. This heuristic performs remarkably well on large-scale test instances.

■ SC04

Level 2 - Room 200D

Selected Topics in Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu

1 - Recent Progress in Gomory and Johnson's Infinite Group Relaxation

Amitabh Basu, University of California-Davis, Davis, CA, United States of America, abasu@math.ucdavis.edu

The infinite group problem was introduced by Gomory and Johnson in the 70s as an elegant infinite dimensional abstraction of general integer programs. Since then it has played a very important role in the theory of deriving valid cutting planes for integer programming problems. We review our recent results regarding extreme valid inequalities for the infinite group problem. A second goal of the talk will be to discuss some of the challenging open problems from this area.

2 - Robust Rankings for American College Football

Sam Burer, Professor, University of Iowa, S346 Pappajohn Business Building, Iowa City, United States of America, samuel-burer@uiowa.edu

We present a model for calculating robust rankings of college football teams. Using several seasons of data, we discover that the top-25 rankings of a well-known computer system are quite sensitive to (hypothetical) changes in the outcomes of games between very weak teams. So we propose a robust variant of the rankings based on computing an optimal solution of a difficult (but not impossible!) optimization problem. We confirm empirically that our rankings are considerably more robust.

3 - A Polyhedral Study of Risk Optimization Problems with Joint Chance Constraints

Ruiwei Jiang, University of Florida, 411 Weil Hall, University of Florida, Gainesville, FL, 32611, United States of America, rwjiang@ufl.edu, Siqian Shen

In this talk, we discuss a class of risk optimization problems with joint chance constraints. We first motivate by introducing its possible applications. Next we reformulate the problem as a mixed integer program and develop a family of valid inequalities. Our preliminary computational results verify the effectiveness of the proposed approaches.

4 - On the Convex Hull of Some Nonlinear Sets

Jean-Philippe Richard, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, richard@ise.ufl.edu, Mohit Tawarmalani, Trang Nguyen

We study how the convex hull of certain nonlinear sets can be obtained through lifting. In particular, for a bilinear set in three variables, we derive a complete (nonlinear) description of the convex hull in the space of original variables. We then provide constructive derivations of these inequalities. Next, we describe how lifting can be used to construct the convex hull of disjunctive sets. We illustrate the applicability of this result by deriving the nonlinear convex hull of simple sets.

■ SC05

Level 2 - Room 200E

Network Applications

Sponsor: Optimization/Networks

Sponsored Session

Chair: Douglas Shier, Clemson University, Mathematical Sciences, Clemson, SC, 29634, United States of America, shierd@clemson.edu

1 - Randomized Heuristics for Handover Minimization in Mobility Networks

Mauricio Resende, AT&T Labs Research, 180 Park Avenue, C241, Florham Park, NJ, 07932, United States of America, mgcr@research.att.com, Luis Moran-Mirabal, José Luis Gonzalez-Velarde, Ricardo Silva

The Handover Minimization Problem (HMP) in Mobility Networks assigns base stations (BS) to radio network controllers (RNC) such that RNC capacity is not violated and the number of handovers between BSs connected to different RNCs is minimized. We show that state-of-the-art IP solvers fail on all but the smallest instances of the HMP. We propose several heuristics for the HMP, including a GRASP with path-relinking (PR), a GRASP with evolutionary PR, and a biased random-key genetic algorithm.

2 - Algorithms and Complexity of Minimum Range Clustering Partitions

Dorit Hochbaum, University of California, Berkeley, Department of IE&OR, Berkeley, Ca, 94720, United States of America, hochbaum@ieor.berkeley.edu, Marjan Baghaie

We introduce a novel criterion in clustering that seeks clusters with limited range of values that characterize each cluster's elements. We propose a number of objective functions that employ the range and mimic known objectives based on sums of similarities. It is demonstrated that range-based problems are in general easier, in terms of their complexity, than the analogous similarity-sum problems, thus presenting a viable alternative to existing clustering criteria, that are NP-hard.

3 - Mitigating Interdiction Scenarios to Enable Species Migration

Jorge Sefair, PhD Student, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, j.sefair@ufl.edu, J. Cole Smith, Robert Fletcher, Miguel Acevedo

We consider a problem in which a species migrates randomly among a network of patches across some region. Interdiction actions on these patches affect the species survival and migration probabilities. Our modeling approach includes an implicit rebalancing of the migration probabilities after the interdictor's actions take place. Our research presents a three-stage optimization model for optimally protecting patches so that the species life expectancy is maximized.

4 - Evaluating and Minimizing "Adversarial Risk" for Hazardous-materials Shipments

Kevin Wood, Distinguished Professor, Operations Research Dept., Naval Postgraduate School, Monterey, CA, United States of America, kwood@nps.edu, Bradford Foster

We model repeated shipments of a hazardous material between a set of origins and destinations in a network, and assume a single, worst-case terrorist attack. "Worst case" implies maximum damage, measured in terms of casualties, property damage, etc. We build models to minimize expected maximum damage by (a) allocating a limited set of decoy shipments, (b) rerouting, or (c) reducing response time to an attack. Tests for realistic settings in the U.S. demonstrate practicability.

■ SC06

Level 2 - Room 200F

Recent Advances in Conic Optimization I

Sponsor: Optimization/Linear Programming and Complementarity

Sponsored Session

Chair: Amir Ali Ahmadi, Goldstine Fellow, IBM Watson Research Center, 1101 Kitchawan Rd., Yorktown Heights, NY, United States of America, a_a_a@mit.edu

1 - Convexification Techniques for Complementarity Constraints

Mohit Tawarmalani, Professor, Purdue University, 100 S Grant Street, Room 4019, West Lafayette, IN, 47907, United States of America, mtawarma@purdue.edu, Trang Nguyen, Jean-Philippe Richard

In this paper, we develop a hierarchy of relaxations for linear programs with complementarity constraints. The technique is similar to reformulation-linearization technique, but uses different product factors. We also derive an equate-and-relax procedure that generates cuts in the space of the original problem variables. As a special case, we strengthen the well-known simple cut and use it to derive cuts that simultaneously exploit multiple complementarity constraints.

2 - Towards Efficient Higher-order Semi-definite Relaxations for Max-cut

Miguel F. Anjos, Canada Research Chair, Ecole Polytechnique de Montreal, C.P. 6079, Succ. Centre-Ville, Montreal, QC, H3C 3A7, Canada, miguel-f.anjos@polymtl.ca, Elspeth Adams, Franz Rendl, Angelika Wiegele

The basic semidefinite relaxation for max-cut can be tightened by adding facet-defining inequalities for the metric polytope, or more generally valid inequalities for the convex hull of incidence vectors of cuts, known as the cut polytope. We start with the basic semidefinite relaxation intersected with the metric polytope, and iteratively refine this relaxation using a new class of cuts called polytope cuts. We present theoretical insights as well as computational results.

3 - Copositive Reformulation of Quadratically Constrained Quadratic Programs

Luis F. Zuluaga, Professor, Lehigh University, 200 West Packer Ave., Bethlehem, United States of America, luis.zuluaga@lehigh.edu, Javier Pena, Juan Vera

A line of recent research looks at how non-convex optimization problems can be reformulated as a copositive optimization problem; that is, a conic program over the cone of copositive matrices. In this talk we discuss the conditions under which a quadratically constrained quadratic program can be reformulated as a copositive optimization problem.

4 - Time Varying Maximum Flow Problem with Polynomial Capacities and Flows

Farid Alizadeh, Professor, Rutgers Business School, Rutgers University, 640 Bartholomew Rd., Piscataway, NJ, 08854, United States of America, farid.alizadeh@rutgers.edu

We consider the maximum flow problem in a network where each arc has a time varying capacity: a univariate polynomial of fixed degree. We seek time varying polynomials representing instantaneous flow on each arc such that the total flow into the sink between times 0 and 1 is maximal. Nonnegative flow should not exceed capacity at any instance between 0 and 1. This problem can be solved by semidefinite programming. We examine extension of classical methods using augmenting paths.

■ SC07

Level 2 - Room 200G

Joint Session OPT/Climate: Compelling Applications of Decision Simulation

Sponsor: Optimization/Stochastic Programming & Climate Change and OR

Sponsored Session

Chair: Suvrajeet Sen, Professor, University of Southern California, Daniel J. Epstein Department of ISE, Los Angeles, CA, 90089, United States of America, S.sen@USC.edu

1 - Multi-stage Stochastic Capacity Expansion using Bender's Decomposition with Sobol Sampling

Mort Webster, Massachusetts Institute of Technology, Cambridge, MA, United States of America, mort@mit.edu, Berk Ustun

We present a multi-stage stochastic capacity expansion model for electricity generation, with uncertainty in future carbon limits, fuel prices, and technology capital costs. Sobol sampling of the joint distribution of the uncertainty allows us to efficiently generate thousands of scenarios. Using this approach, we demonstrate that the first-stage optimal mix depends critically on interactions between the uncertainties in policy, fuel prices, technology costs, and the time horizon.

2 - A Simulation-optimization Approach for Wildfire Extended Attack Response Planning

Lewis Ntaimo, Associate Professor, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX, 77843, United States of America, ntaimo@tamu.edu, Michelle Alvarado

We consider a simulation-optimization methodology for wildfire extended attack planning, which involves dispatching firefighting resources to suppress escaped wildfires. We formulate the problem as a multi-period two-stage stochastic integer program to determine the location and strategies of firefighting resources over a rolling horizon. A fire behavior and suppression simulation generates scenarios at each period to provide information on fire spread under uncertain weather conditions.

3 - Simulation-based Robust Optimization for Complex Truck-shovel Systems in Surface Coal Mines

SaiSrinivas Nageshwaraniyer, The University of Arizona, 1502 E 10th 134, Tucson, AZ, 85719, United States of America, ngsaisrinivas@gmail.com, Young-Jun Son

A robust simulation-based optimization approach is proposed for truck-shovel systems in surface coal mines to maximize the revenue. A large coal mine is taken as case study and its highly detailed simulation model is constructed. Response Surface Methodology is then applied to the simulation model to derive variance of revenue under the influence of controllable and uncontrollable factors. The proposed approach results in higher and robust revenues compared with historical revenues.

■ SC08

Level 2 - Room 200H

Allocation and Task Mapping: Parallel Resource Management After a Job is Scheduled to Run

Sponsor: Computing Society

Sponsored Session

Chair: Vitus Leung, Sandia National Labs, PO Box 5800, Albuquerque, NM, United States of America, vjleung@sandia.gov

1 - A Tale of Two HPC Networks: Evaluating Node Orderings for Torus and Dragonfly Topologies

Carl Albing, Cray Inc., 380 Jackson Street, Suite 210, St. Paul, MN, 55101, United States of America, albing@cray.com

HPC application performance can vary in torus-based HPC systems. Node ordering is a way to factor topology into the placement decision to increase compactness. Several orderings have been proposed. What is the basis for choosing one ordering over others? A method is described for the static evaluation of a node ordering in a torus. Results provide visually compelling guidance on the choice of node ordering. A new dragonfly network is described and its implications for placement are discussed.

2 - Job Allocation Methods to Optimize Communication and Cooling Costs in HPC Data Centers

Ayse Coskun, Boston University, 8 Saint Mary's St., ECE Department, Boston, MA, 02215, United States of America, acoskun@bu.edu, Jie Meng, Fulya Kaplan

Nearly half of the energy in the computing clusters is devoted to cooling. Existing thermally-aware job allocation policies do not consider the communication among the threads of an application while making decisions. However, performance of multi-threaded high performance computing (HPC) applications is strongly affected by the distances among the communicating nodes. This talk discusses a novel job allocation method to minimize the communication cost while also reducing the cooling energy.

3 - Task Mapping for Non-contiguous Allocations

Vitus Leung, Sandia National Labs, PO Box 5800, Albuquerque, NM, United States of America, vjleung@sandia.gov, David Bunde, Johnathan Ebbers, Nickolas Price, Matthew Swank, Stefan Feer, Zachary Rhodes

Several studies have shown that task placement affects job running time for both contiguously and non-contiguously allocated jobs. This paper examines task mapping algorithms for non-contiguously allocated parallel jobs. We apply novel and adapted task mapping algorithms to this setting and evaluate them using experiments and simulations. Our strategies improve running time by as much as thirty percent over a baseline strategy. Furthermore, this improvement increases markedly with the job size.

4 - Improving the Scalability of Parallel Applications through Genetic Algorithm based Task Reordering

Ramanan Sankaran, Computational Scientist, Oak Ridge National Laboratory, MS 6008, PO Box 2008, Oak Ridge, TN, 37831, United States of America, sankaranr@ornl.gov, Mike Brown, Jordan Angel

We study the impact of task placement on the parallel performance of a turbulent combustion solver (S3D) and a molecular dynamics code (LAMMPS), on the Titan Cray XK7 supercomputer at the Oak Ridge Leadership Computing Facility. A new strategy using genetic algorithm that takes into account the parallel application's communication pattern is presented. The technique provides a reordered placement, within the set of nodes allocated by the job scheduler, to minimize the communication overhead.

■ SC09

Level 2 - Room 200I

Big Data Analytics for Cybersecurity

Sponsor: Analytics Section

Sponsored Session

Chair: Alla Kammerdiner, Assistant Professor, New Mexico State University, PO Box 30001, MSC 4230, Las Cruces, NM, 88003, United States of America, alla@nmsu.edu

1 - Network Inference for Monitoring Cyber-physical Systems (CPS)

Alla Kammerdiner, Assistant Professor, New Mexico State University, PO Box 30001, MSC 4230, Las Cruces, NM, 88003, United States of America, alla@nmsu.edu

CPS emergence in power grid, healthcare, and manufacturing poses new challenges in systems engineering. Safety, privacy, and security require CPS monitoring to prevent blackouts and disruptions, exposure of private data, loss of strategic advantage. Standard security monitoring comes short. Big Data in CPS operations requires new network science, to allow sensitivity and scalability. We propose methodology for monitoring security of cyber-physical systems and illustrate numerically.

2 - Network Economics of Cyber Crime with Application to Financial Service Organizations

Anna Nagurney, John F. Smith Memorial Professor, University of Massachusetts, Isenberg School of Management, Amherst, MA, 01003, United States of America, nagurney@isenberg.umass.edu, Senay Solak, Wayne Burleson, Mila Sherman, Christopher Misra

In this presentation, we will describe the multidisciplinary research conducted as part of an Advanced Cyber Security Center grant on Cyber Security Risk Analysis and Investment Optimization. A specific network economics model of cyber crime will also be described along with theoretical foundations and prospective empirical applications.

■ SC10

Level 2 - Room 200J

Case Competition II

Sponsor: INFORM-ED

Sponsored Session

Chair: Palaniappa Krishnan, Associate Professor, University of Delaware, 531 S.College ave., Newark, DE, 19716, United States of America, baba@udel.edu

1 - Case Competition

Palaniappa Krishnan, Associate Professor, University of Delaware, 531 S.College ave., Newark, DE, 19716, United States of America, baba@udel.edu

INFORMed's Annual Case Competition is an Opportunity for INFORMS Members to Showcase Their Efforts in the Classroom. Cases are Often Later Published.

■ SC11

Level 2 - Room 201A

Network Design

Sponsor: Telecommunications

Sponsored Session

Chair: Luis Gouveia, Univ Lisbon, Campo Grande, Lisbon, Portugal, legouveia@fc.ul.pt

1 - An Empirical Analysis of the Triples Formulation of the Network Design Problem

Eli Olinick, Associate Professor, Southern Methodist University, PO Box 750123, Dallas, TX, 75275, United States of America, olinick@lyle.smu.edu

We present an empirical study comparing a new, compact formulation of the network design problem to the classical node-edge and edge-path formulations.

2 - Spanning Trees with Variable Degree Bounds

Luis Gouveia, Univ Lisbon, Campo Grande, Lisbon, Portugal, legouveia@fc.ul.pt, Pedro Moura, Amaro Sousa

We describe a minimum spanning tree problem with variable degree bounds and where the cost of each edge depends on the degree of its end nodes and where edges with a higher cost enable higher degrees. This problem is motivated by the design of wireless networks. We propose three classes of models using different sets of variables and compare from a theoretical perspective as well as from a computational point of view, the models and the corresponding linear programming relaxations.

3 - A Stochastic FTTH Splitter Location-allocation Problem
Jeongyi Moon, Korea University, Sung-buk Gu, Anam-dong 5ga, Seoul, Korea, Republic of, jeongyiimoon@gmail.com, Youngho Lee, Gigyoung Park, Junsang Yuh

We present a stochastic integer programming approach to solving a fiber-to-the-home passive optimal network (FTTH-PON) design problem with stochastic demand. We propose valid inequalities and heuristic strategies that enhance the basic L-shaped algorithm within the context of branch-and-cut procedure. We also demonstrate various reformulation-techniques that facilitate to devise new solution procedures.

4 - Determining OSPF Routing Policies in the Presence of Active Queue Management
Jiaxin Liu, University of Waterloo, 200 University Avenue West, Waterloo, Canada, j69liu@uwaterloo.ca, Stanko Dimitrov, Laura Sanita

We propose a mathematical model to derive OSPF routing policies in the presence of router active queue management. We discuss the computational complexity of the proposed general model. A modified model is proposed to ensure edge weights are realizable and feasible. We conclude by showing the derived routing policies tend to perform better than those used in a real world network.

■ SC12

Level 2 - Room 201B

Nicholson Student Paper Competition: Finalists I

Cluster: Nicholson Student Paper Prize

Invited Session

Chair: Jose Blanchet, Professor, Columbia University, 500W 120th Street, New York, NY, United States of America, jose.blanchet@columbia.edu

1 - Nicholson Student Paper Prize
Jose Blanchet, Professor, Columbia University, 500W 120th Street, New York, NY, United States of America, jose.blanchet@columbia.edu, Huseyin Topaloglu

The top participants in the Nicholson student paper competition are selected as finalists by the prize committee and invited to present their work in these sessions. This competition comprises papers of the highest quality drawn from virtually all areas represented by INFORMS.

■ SC13

Level 2 - Room 202A

Innovation with Crowds I

Cluster: New Product Development

Invited Session

Chair: Joel Wooten, University of South Carolina, Moore School of Business, Columbia, SC, United States of America, joel.wooten@moore.sc.edu

1 - Finding a Partner in the Crowd
Michael Menietti, Harvard-NASA Tournament Lab, 1737 Cambridge Street, Cambridge, MA, 02138, United States of America, mmenietti@fas.harvard.edu, Kevin Boudreau, Christoph Reidl, Karim Lakhani, Andrea Blasco

We ran a large team-formation and matching experiment where participants formed virtual teams of size two, working together over the course of one month to develop an algorithm. We test whether the introduction of a centralized "clearinghouse" based on elicited rankings can improve matching outcomes. While the centralized markets maximized the number of stable pairs, pairs formed in decentralized markets are more likely to produce valid algorithms.

2 - Incentives and Competitive Crowds
Yael Grushka-Cockayne, University of Virginia, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, GrushkaY@darden.virginia.edu, Casey Lichtendahl, Phil Pfeifer

When individuals are asked to forecast an uncertain quantity, they often face incentives to be the most accurate. Despite the desire to elicit honest forecasts, such competition induces forecasters to report strategically and non-truthfully. The question we address is how incentive schemes influence the accuracy of the crowd's forecast. We show that forecasting competitions may be attractive alternatives to prediction markets because they are easy to implement and may be more accurate.

3 - Incentives and Competition in Unblind Innovation Contests
Anant Mishra, Professor, George Mason University, Fairfax, VA, United States of America, amishra6@gmu.edu, Cheryl Druehl, Jesse Bockstedt

Innovation contests are being widely used by firms to generate creative solutions to complex problems. Using a large panel dataset of unblind innovation contests from an online logo-design platform, we examine the interplay or prize amount and contestant's prior winning experience on the dynamics of competition in unblind innovation contests.

■ SC14

Level 2 - Room 202B

Supply Chain Vulnerability Mitigation

Cluster: Managing Disruptions in Supply Chain

Invited Session

Chair: Chase Rainwater, University of Arkansas, Bell Engineering Center, Fayetteville, AR, 72701, United States of America, cer@uark.edu

1 - Quantity Discounts in Two Echelon Supply Chains with Transshipping Retailers
Frank Ciarallo, Associate Professor, Wright State University, 3640 Col Glenn Hwy, Dayton, OH, 45435, United States of America, frank.ciarallo@wright.edu, Gregory Noble

Pricing contracts between suppliers and retailers allow a supplier to coordinate the actions of competing retailers facing uncertain demand. We study quantity discount contracts between a supplier and two competing retailers that already agree to transship stock to maximize service levels. We study different forms of discount contracts to determine which give the supplier successful coordinating influence, thus improving the performance of either suppler, retailer or the entire supply chain.

2 - Imperfect Protection of Infrastructure using Stochastic Programming with Endogenous Uncertainty
Hugh Medal, Assistant Professor, Mississippi State University, 260 McCain Engineering Building, Mississippi State University, MS, 39762, United States of America, hugh.medal@msstate.edu

We examine common assumptions in infrastructure protection models: 1) perfect protection, 2) binary protection, and 3) binary infrastructure states. We employ a two-stage stochastic program with endogenous uncertainty and solve it using a greedy algorithm with a performance guarantee. We found that assumptions 1 and 2 together significantly affected model performance, and yet assumption 3 did not have a significant effect. We also found a significant interaction between assumptions 1, 2, and 3.

3 - An Integrated Response and Recovery Model for Disaster Relief Operations Support
Kasin Ransikarbum, Department of Industrial Engineering, Clemson University, 110 Freeman Hall, Clemson, SC, 29630, United States of America, Kransik@clemson.edu, Scott Mason

While logistics research recently has placed increased focus on disaster relief operations, few studies have examined the response and recovery phases in post disaster operations. We present an integrated network optimization model for making strategic decisions in both the supply distribution and network restoration domains. We discuss equity-based solutions for constrained budget problems to provide decision makers with candidate restoration and distribution plans.

■ SC15

Level 2 - Room 203

Models of Co-creation

Sponsor: Service Science

Sponsored Session

Chair: Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 23060, United States of America, ralphb@vt.edu

1 - Service-dominant Logic: Are Customers Operant Resources?
Christoph Heitz, Zurich University of Applied Science, Postfach 805, Winterthur, 8401, Switzerland, heit@zhaw.ch

According to Service Dominant Logic (S-D logic), the basis for all exchange is the application of operant resources. These are typically defined as knowledge and skills of the provider. In extension to this view, we argue that customers, too, should be seen as operant resources of the provider. We show with a simple model that this may improve the service creation significantly.

2 - Designing and Pricing Services Based on Customer-Perceived Value: An Airline Company Feasibility Study
Francesco Moresino, Professor, Haute Ecole de Gestion de Genève, HESSO, 7 Route de Drize, Genève, 1227, Switzerland, francesco.moresino@hesge.ch, Angela Lombardi, Emmanuel Fragnière

Revenue management models heavily rely on the carrier's historical booking patterns to forecast passenger demand and to recommend optimal inventory controls. We are presenting a new integrated model for pricing airline tickets that takes into account the perceived value of multiple services in different competitive environments. Our integrated model includes a classical aggregate planner for services as well as a share of choice model and can be implemented as a decision support tool.

3 - Viability and Service Evolution
Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 23060, United States of America, ralphb@vt.edu

We examine the trajectories of a service through service processes within a service ecosystem. By modeling the decisions of agents in terms of fuzzy decision models which reflect the abductive phase of service innovation we establish a framework for describing the trajectories of different types of agents in different types of service systems. We also provide a precise and measurable definition of service viability and connect the performance of trajectories to the viable systems approach (VSA).

■ SC16

Level 2 - Room 204

Pierskalla Award

Sponsor: Health Applications

Sponsored Session

Chair: Vishal Ahuja, University of Chicago, United States of America, vahuja@chicagobooth.edu

Co-Chair: John Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - Pierskalla Award
Vishal Ahuja, University of Chicago, United States of America, vahuja@chicagobooth.edu, John Birge

The Health Applications Society of INFORMS sponsors an annual competition for the Pierskalla Award, which recognizes research excellence in the field of health care management science. The award includes a $500 honorarium for the best paper presented in a Health Applications Society sponsored session at the annual INFORMS conference. The award is named after Dr. William Pierskalla to recognize his contribution and dedication to improving health services delivery through operations research. The Pierskalla award information can be found on the website at: https://www.informs.org/Community/HAS/Pierskalla-Award.

■ SC17

Level 2 - Room 205A

Services Operational Measures and Analytics

Sponsor: Service Science

Sponsored Session

Chair: Genady Grabarnik, Assistant Professor, St. John's University, Dept. Math & CS, 8000 Union, Queens, NY, United States of America, grabarng@stjohns.edu

Co-Chair: Larisa Shwartz, IBM, Hawthorne, NY, United States of America, lshwart@us.ibm.com

1 - The Effect of the Boundary Conditions on the Operating Characteristics of a Service Delivery Test
Yefim Michlin, Technion – Israel Institute of Technology, Technion, Faculty IE&M, Haifa, 32000, Israel, yefim@technion.ac.il, Genady Grabarnik, Larisa Shwartz

A test is designed to assess the mean service time spent by a server on a maintenance request by a client. We refer to the server as a member of a group of relatively homogeneous system administrators in a large service center. This article analyzes the impact of non-stationarity of the service process at the beginning and end of the day on the operational characteristic of the test. The recommendations on the optimal ratio of the service group size and duration of the test are suggested.

2 - Operational Innovation through Continuous Automation
Larisa Shwartz, IBM, Hawthorne, NY, United States of America, lshwart@us.ibm.com, Genady Grabarnik

Modern service management focuses on the development of tools and methods for improving service's efficiency and quality. It's desirable to run a service in a fully automated environment, but hardly achievable. In this paper we discuss data driven Continuous Automation process: examine automatobility assessment process, which identifies activities of the next greatest impact; and review how to estimate and measure gains from a process automation of the divers service delivery environments.

3 - Normative Value-Principles: Bases for Nash Equilibrium
Victor Tang, IBM, 55 Deerfield Lane South, pleasantville, NY, 10570, United States of America, victor.w.tang@gmail.com

Value is overused and abused in services. We propose to inject analytic rigor to the notion of value. We present six normative principles for determining the value of a service from the vantage points of the provider as well as the client. The principles are based on game theory, behavioral economics, financial accounting, and cognitive psychology. From these principles, we are able to derive the price of a service at which a Nash Equilibrium is established. We illustrate this with an example.

4 - Merge of Large Number of Service Specific Distributions and Robustness of Sequential Test
Genady Grabarnik, Assistant Professor, St. John's University, Dept. Math & CS, 8000 Union, Queens, NY, United States of America, grabarng@stjohns.edu, Larisa Shwartz, Yefim Michlin

We trying to explain why the merge of 14 or more service specific distributions resulting distribution is closed to exponential distribution. We use this result to conclude robustness of the sequential test for large group of servers.

■ SC18

Level 2 - Room 205B

The Social Aspect

Sponsor: Service Science

Sponsored Session

Chair: Bing Shao, Staff Researcher, IBM Research China, Haidian District, Beijing, P.R.C., Beijing, China, shaobing@cn.ibm.com

1 - How Online Social Media Changes Volunteer Recruitment
Amy Connolly, Doctoral Candidate, University of South Florida, 4202 E. Fowler Avenue, CIS1040, Tampa, FL, 33620, United States of America, ajconnol@usf.edu, Anol Bhattacherjee

Volunteer recruitment in organizations poses a unique problem, because volunteers are not simply unpaid employees. Volunteers have competing demands on their time, and quality volunteers can be hard to find. This paper considers the role of online social media in attracting new volunteers to join the organization. We extend theories from psychology, sociology and information systems, to test the impact of online social media on an individual's willingness to volunteer.

2 - Social Enterprising Elderly Healthcare within Community Care Depots in Taiwan
Ruey-Fa Lin, Feng Chia Univestiy, Taichung, Taiwan - ROC, rflin@fcu.edu.tw

The community care ideologies have been increasingly stressed for their convenience in providing effective, accessible, acceptable, affordable and efficient services in concerns for the aged. Inventing community care depots is characterized by socially value public services for almost a decade in Taiwan. Elderly people are being served and satisfied with the delivered provisions by different indigenous corporates within cultural contexts in their own civil society at large.

3 - Architecture for Social Analytics in Smarter Commerce
Bing Shao, Staff Researcher, IBM Research China, Haidian District, Beijing, P.R.C., Beijing, China, shaobing@cn.ibm.com, Tao Qin, Hao Ji, Miao He, Changrui Ren, Jinfeng Li

The prosperity of social media is transforming the way of business and customer interaction. Social business insight elevates diagnosis and predictive capability on brand, product or service for commerce companies. We develop a reference architecture that focuses on the process and system level for the description of social analytics. This architecture can be used for integration with new and traditional business process workflows, aligned with the implementation of company social strategy.

■ SC19

Level 2 - Room 205C

Optimal Control of Queues

Sponsor: Applied Probability

Sponsored Session

Chair: Hayriye Ayhan, Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, hayhan@isye.gatech.edu

1 - Distributed Backup Scheduling: Modeling and Optimization

Bo Zhang, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10598, United States of America, zhangbo@us.ibm.com, Peter van de Ven, Angela Schoergendorfer

We propose a novel Markov chain model to describe the (distributed) data backup process and analyze its stability conditions and stationary behavior. Then we study how to choose a backup scheduling policy that strikes the right balance between performing frequent backups to improve data safety and reducing backup costs.

2 - Network Coding Decisions for Wireless Transmissions with Delay Consideration

Arupa Mohapatra, PhD Student, Texas A&M University, Industrial and Systems Engineering, 3131 TAMU, College Station, TX, 77843, United States of America, arupa@tamu.edu, Srinivas Shakkottai, Alex Sprintson, Natarajan Gautam

We consider a wireless relay node which uses network coding technique to efficiently transmit packets. However, coding opportunities do not always exist, and waiting for a coding opportunity could result in excessive delay in transmission. We develop a Markov decision process (MDP) model to decide whether to transmit a packet uncoded or wait for transmission in future. We compare the optimal policy in this MDP against other simple heuristic policies.

3 - Dynamic Server Assignment in a Finite-population Queuing System

Nilay Tanik Argon, University of North Carolina, Department of Statistics and OR, Chapel Hill, NC, United States of America, nilay@unc.edu, Chao Deng, Vidyadhar Kulkarni

We study the dynamic control of a single server in a finite-population queueing network. We prove that under certain routing structures, the policy that assigns the server to a job that has the shortest remaining service time in some stochastic sense maximizes the long-run average throughput. Our numerical results show that this policy could also be a good heuristic for systems with more general routing structures.

4 - Optimal Dynamic Pricing for Tandem Queueing Systems

Xinchang Wang, PhD Student, Georgia Institute of Technology, Main 316, 755 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, xwang336@gatech.edu, Sigrun Andradottir, Hayriye Ayhan

We study tandem queueing systems with two stations and finite buffers, in which the queue manager quotes prices for incoming customers from a set of discrete prices. Our goal is to determine the dynamic pricing policy that maximizes the long-run average profit. We show that the optimal policy exhibits a monotone structure, in which the quoted prices have greater dependency on the queue length at station 1 than at station 2.

■ SC20

Level 2 - Room 205D

Heavy Tails in Applied Probability

Sponsor: Applied Probability

Sponsored Session

Chair: Josh Reed, New York University, 44 West 4th St., New York, NY, 10012, United States of America, jreed@stern.nyu.edu

1 - Drift in Transaction-level Asset Price Models

Wen Cao, New York University, 44 West 4th St., New York, NY, 10012, United States of America, wcao@stern.nyu.edu, Cliff Hurvich, Philippe Soulier

We study the effect of drift in pure-jump transaction-level models for asset prices in continuous time, driven by point processes. It links properties of durations (heavy tails and long memory) to properties of average returns, making it difficult to determine growth rates. We focus on a univariate model for log price, allowing for both long memory and heavy tails in durations. We propose a robust ratio statistic, obtain its limiting distributions, and employ subsampling to test growth rates.

2 - Power Line Control Strategies under Different Tail Distributions of Ambient Temperature

Juan Li, Columbia University, 500 West 120th Street, New York, NY, 10027, United States of America, jl3035@columbia.edu, Daniel Bienstock, Jose Blanchet

We discuss a control scheme for maintaining low failure probability of a transmission system power line under thermal stress. When the distribution of the ambient temperature changes, so does the dependence of the failure probability as a function of line current. The theory of extremes of Gaussian random fields is used to guide the size of the underlying frequency inspection so as to insure that current is effective for controlling the risk of overheating.

3 - Scheduling on a Channel with Failures and Retransmissions

Evangelia Skiani, Columbia University, 423 West 118th Street, New York, NY, 10027, United States of America, es3009@columbia.edu, Predrag Jelenkovic

In communication systems, retransmission-based failure recovery represents a foundation for mechanisms that guarantee successful data delivery in the presence of failures. It was shown that retransmissions can cause heavy-tailed delays even if all traffic and network characteristics are light-tailed. Here, we consider transmitting data over a channel of fixed capacity that fails between successive iid availability periods. We study the impact of scheduling strategies on the system performance.

4 - Series Expansions for Random Walks

Josh Reed, New York University, 44 West 4th St., New York, NY, 10012, United States of America, jreed@stern.nyu.edu, Cliff Hurvich

We present a new proof for a series expansions for the expected value of the first ascending ladder height of a Gaussian random walk in terms of mean increment size. Extensions of our result to heavy-tailed increments are also discussed.

■ SC21

Level 2 - Room 206

Optimization Models for Scheduling Problems in Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Xiuli Qu, Associate Professor, North Carolina A&T State University, 1601 E. Market Street, Greensboro, NC, 27411, United States of America, xqu@ncat.edu

1 - A Pattern-Driven Optimization Approach for Appointment Scheduling

Michele Samorani, University of Alberta, School of Business, Edmonton, Canada, samorani@ualberta.ca, Bora Kolfal

We consider a clinic with stochastic service times, undifferentiated providers, heterogeneous patients, and 30% no-show rate. Due to the many stochastic inputs to consider, it is hard to solve the problem analytically. So, to find general solutions to the problem, we employ a pattern-driven optimization approach: first, we use simulation to find good schedules for different problem instances; then, we analyze these schedules through data mining to find patterns that are desirable in any schedule.

2 - A DES-GA Method to Determine the Optimal Scheduling Templates for Open Access Clinics with Walk-ins

Yidong Peng, North Dakota State University, 2940 7th St. N., Apt 4, Fargo, ND, 58102, United States of America, yidong.peng@ndsu.edu, Jing Shi, Xiuli Qu

In this research, we developed a discrete event simulation and genetic algorithm (DES-GA) approach to find the optimal scheduling template under the clinic setting that admits both open access and walk-in patients by minimizing the average cost per admission of open access or walk-in patient. Our results show that the optimal scheduling templates are significantly affected by the patient attendance rate, level of demands of same-day appointment and walk-in admissions, and cost coefficients.

3 - Two Multi-period Dynamic Relocation Models for Emergency Response

Jianing Zhi, University of Alabama, 300 Alston Hall, Tuscaloosa, AL, 35487, United States of America, jzhi@crimson.ua.edu, Burcu Keskin, Sharif Melouk

We investigate two multi-period ambulance relocation problems for daily ambulance operations using p-median models: 1) all incidents require service in the period in which they occur, and 2) incident service delays are allowed for a cost. Facility location, fleet size, incident pattern, and time-dependent factors are considered in the experimentation while comparing the two models. We analyze the trade-off between service quality and cost quantitatively via a detailed sensitivity analysis.

4 - Optimization Models for Scheduling Elective Surgery Patients under Constraint of Downstream Units
Ergin Erdem, North Dakota State University, 1340 Administration Ave., Fargo, United States of America, Ergin.Erdem@my.ndsu.edu, Jing Shi

In this research, we develop a two-stage stochastic mixed integer linear programming model for scheduling elective surgery patients. The resource availability as well as the possibilities for expanding the current resource levels for operating rooms and downstream clinic units is considered in the model. The scenarios representing various durations of surgical operations are incorporated and the model is solved by employing the approach of sample average approximation.

■ SC22

Level 2 - Room 207

Dosage Determination for Complex Toxicological Experiments

Cluster: Healthcare Systems/Informatics

Invited Session

Chair: Edward Boone, Associate Professor of Statistics, Virginia Commonwealth University, 1001 West Main Street, Richmond, VA, 23112, United States of America, elboone@vcu.edu

1 - Bayesian Model Averaging in Benchmark Dose Estimation
Susan Simmons, Professor of Statistics, University of North Carolina Wilmington, 401 S. College Rd., Wilmington, NC, United States of America, simmonssj@uncw.edu, Cuixian Chen, Xiaosong Li, Qijun Fang, Walter Piegorsch

The use of Benchmark Dose Estimation has dramatically increased over the past decade. Many US government agencies and research laboratories use benchmark dose methodology to estimate the allowable dose of hazardous agents. The main drawback of this methodology is that a dose-response curve must be specified in order to estimate the benchmark dose. Herein, we illustrate an alternative to specifying one benchmark dose curve and utilized Bayesian model-averaging.

2 - Determining the Optimal Dosage using Metamodeling Techniques
Xi Chen, Assistant Professor, Virginia Commonwealth University, Statistical Sciences & Operations Resear, 1015 Floyd Avenue, Grace E. Harris Hall, Richmond, VA, 23284-3083, United States of America, xchen4@vcu.edu, Edward Boone

This talk is about determining the optimal dosage while controlling for tolerable side effects through metamodeling techniques with a Bayesian perspective. The sampled posterior optimization programs are constructed using metamodels to determine the posterior distribution of the optimal dosage. The goal is to maximize the benefit of using the dosage and simultaneously control the side effects, explicitly for each individual subject, with a prescribed posterior probability guarantee.

3 - Determining Tolerable Dosages with Multiple Responses and Multiple Predictors
Edward Boone, Associate Professor of Statistics, Virginia Commonwealth University, 1001 West Main Street, Richmond, VA, 23112, United States of America, elboone@vcu.edu

Determining tolerable dosages/exposures to toxic substances is often complicated by ill defined endpoints that can be measured by multiple outcome variables. This is further complicated by having multiple stressors/predictors. This talk presents a novel method for determining tolerable dosages using a Bayesian approach for this situation.

4 - Optimal Design for Complex Toxicology Experiments
Naha Farhat, PhD Candidate, Virginia Commonwealth University, 2306 Cascade Meadows Drive, Midlothian, VA, 23112, United States of America, farhatnj@vcu.edu

Toxicology experiments often involve multiple responses and multiple predictors from which tolerable dosage limits will be inferred. An optimal experimental design strategy is presented considering A, E, and D optimal designs as well as weighted and most probable design criteria.

■ SC23

Level 2 - Room 208A

New Approaches to Dynamic Pricing and Demand Estimation

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Dana Popescu, Assistant Professor of Technology and Operations Management, INSEAD, 1 Ayer Rajah Ave., Singapore, 138676, Singapore, Dana.Popescu@insead.edu

1 - Dynamic Targeted Pricing
Dan Zhang, University of Colorado at Boulder, 995 Regent Dr, Boulder, CO, 80305, United States of America, Dan.Zhang@Colorado.EDU, Chuan He

We consider dynamic targeted pricing problem for a monopolist selling to two customer segments. Implications of targeting accuracy and customers' intertemporal purchasing behavior are discussed. We also compare the efficiency of dynamic pricing with that of targeting.

2 - Price Matching under Conditional Discounts in the Presence of Strategic Consumers
Navaporn Surasvadi, New York University, 44 West Fourth St., New York, NY, 10012, United States of America, nsurasva@stern.nyu.edu, Gustavo Vulcano

We study a RM problem in which a seller operates a markdown setting with a price-match guarantee. Arriving consumers decide whether to buy the item at full price or wait for a possible discount. At the end of the season, the seller will reimburse the price difference to the full-price buyers who claim the refund. We prove the existence of an equilibrium consumer's strategy in this game. Then, through a numerical study, we test the performance of our proposed mechanism.

3 - An Econometric Analysis of Black Friday Sales in Retail
Nikolay Osadchiy, Assistant Professor, Emory University, Robert Goizueta Business School, Atlanta, GA, United States of America, nikolay.osadchiy@emory.edu, Vishal Gaur

Black Friday is one of the most anticipated sales events for the US retailers. Using the state of the art non-parametric method we estimate the mix of consumers during the Black Friday, whether they postpone purchases or buy in advance, as well as their distribution of preferences over products.

■ SC24

Level 2 - Room 208B

Big Data Analytics Case Studies in Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Jon Higbie, Managing Partner and Chief Scientist, Revenue Analytics Inc, 3100 Cumberland Blvd SE, Suite 1000, Atlanta, GA, 30339-5930, United States of America, jhigbie@revenueanalytics.com

1 - RM - Business Function that Owns Big Data
Dev Koushik, Director, Revenue Optimization, InterContinental Hotels Group, Atlanta, GA, United States of America, dev.koushik@ihg.com

"Big Data" as it is being portrayed in the media right now has existed in the world of Revenue Management right from the days of its inception. The business function of Revenue Management evolved from using data as a lever to make strategic pricing and inventory decisions in the travel and transportation industry. This presentation will make a case for why Revenue Management should lead the organization in this evolution through its expertise of managing business using data and science.

2 - Increasing Marketing Engagement using Graph-augmented A/B Testing at MailChimp.com
John Foreman, Data Scientist, MailChimp.com, Atlanta, GA, United States of America, john.foreman@mailchimp.com

MailChimp.com sends 5 billion email marketing newsletters per month; the site's users leverage A/B testing to "optimize" their content. While a small business might not have the historical data to facilitate any other approach, most email addresses in MailChimp's system are subscribed to multiple newsletters. This subscription data yields an email address interest graph that can inform A/B testing. This talk will explore the initial results of this network-informed A/B testing concept.

3 - Tactics for Structuring Big Data for Analysis
Helen (Xianzhi) Wang, Quantitative Analyst, Google, 1600 Amphitheatre Parkway, Mountain View, CA, 94043, United States of America, xzwang@gmail.com

Cloud and big data open source technologies have made big data analytics more approachable. In order to effectively use big data to draw insights and make better decisions for the business, it is important to analyze then structure the data for the intended purpose. This talk aims to share some tactics to handle big data tables so that it becomes more accessible to analytic models.

4 - Big Data Means Nothing without Big Data Analytics
Anand Srinivasan, Consultant, Revenue Analytics, 3100 Cumberland Blvd., Suite 1000, Atlanta, GA, 30339, United States of America, asrinivasan@revenueanalytics.com, Jon Higbie

Big Data is defined by 3Vs of data, Volume, Variety and Velocity. Technically, Big Data refers to storage and processing of large data, but in common usage, it refers to insights provided by the data. Industries like Revenue Management have a rich experience of crunching large datasets to better segment their customers and provide more targeted offerings to consumers. To best utilize Big Data capabilities, industries need to scale the 3 Vs of Big Data to match their execution capabilities.

■ SC25

Level 2 - Room 208C

Ad Auctions

Cluster: Auctions

Invited Session

Chair: De Liu, University of Kentucky, 425D Gatton B&E Building, Lexington, KY, 40506, United States of America, de.liu@uky.edu

1 - Optimal Dynamic Auctions for Display Advertising
Ying-Ju Chen, University of California-Berkeley, Department of Industrial Engineering, Berkeley, CA, United States of America, chen@ieor.berkeley.edu

In this paper, we investigate the optimal dynamic auction design for the display advertising industry. We characterize the precise tradeoffs between extracting the revenue from the spot markets, materializing the instantaneous benefit shared with the guaranteed advertisers, and releasing the pressure of paying the penalty eventually. We also demonstrate the inherent stochastic scheduling issue embedded in this dynamic revenue management problem.

2 - Discrete Choice Models of Bidder Behavior in Sponsored Search
Sebastien Lahaie, Microsoft Research, New York, NY, 10016, United States of America, slahaie@microsoft.com

There are two kinds of bidders in sponsored search: those who keep their bids static and those who actively manage their bids. We develop a model of bidder behavior in sponsored search that applies to both types. All advertisers see substantial variation in rank, which motivates a discrete choice approach that bypasses bids and directly models an advertiser's choice of rank. An empirical evaluation confirms that our model performs well in terms of predicting realized ranks and clicks.

3 - Quality Score that Makes You Invest
Yi Zhu, University of Southern California, 3660 Trousdale Parkway, ACC306E, Los Angeles, CA, 90089, United States of America, zhuy@usc.edu, Zsolt Katona

Many search engines and other ad auctions use a quality score to favor certain advertisers in the auction. The results suggest that often a type of quality score that considers both advertisers' qualities and CTR than one that only CTR is optimal. Such a quality score increases both advertisers' qualities and the auctioneer's revenue. These results are stronger when there are (i) more advertising slots, (ii) when these slots are similar, and (iii) when quality investments are expensive.

■ SC26

Level 2 - Room 208D

Location and Transportation

Sponsor: Location Analysis

Sponsored Session

Chair: Rakesh Nagi, Professor, Industrial and System Engineering Department, 309 Bell Hall, University at Buffalo, Buffalo, NY, 14260, nagi@buffalo.edu

1 - Optimal and Heuristic Procedures for the Placement of Two Finite-size Facilities in a Planar Layout
Ketan Date, PhD Student, University at Buffalo, 438 Bell Hall, Buffalo, NY, 14260, United States of America, ketandat@buffalo.edu, Shailesh Darekar, Rakesh Nagi

In this work, we propose a new lower bounding procedure for the optimal placement of the two finite-size facilities, which can effectively eliminate sub-optimal candidates, resulting in faster convergence. We also study some heuristic procedures and conduct extensive numerical comparison with the optimal procedure, in terms of solution quality and computing time.

2 - Locating Noisy Counting Sensors to Estimate Network Flows
Pitu Mirchandani, Professor, Arizona State University, 699 S. Mill Ave., Tempe, AZ, 85281, United States of America, pitu@asu.edu, Ning Wang

The following problem is addressed. There are unknown flows on known routes. There is some probabilistic prior knowledge on the flows. We can locate some sensors that provide flow rates with known reliabilities. We seek the optimal locations of these sensors using a Bayesian framework for estimating flows.

3 - Stochastic Dynamic Itinerary Interception Refueling Location for EV Taxi Charging Stations
Jaeyoung Jung, Assistant Project Scientist, University of California, Irvine, Institute of Transportation Studies, 4000 Anteater Instruction and Research B, Irvine, CA, 92697-3600, United States of America, jyoungjung@gmail.com, Joseph Chow, R. (Jay) Jayakrishnan, Ji Young Park

A facility location model for EV taxi charging station is proposed, which considers: (1) itinerary-interception; (2) stochastic demand as dynamic passenger requests; (3) queue delay at stations. A bi-level simulation-optimization solution method is used to combine upper level multi-server allocation model and lower level dispatch simulation. The solution algorithm is tested on a fleet of 600 shared-taxis in Korea, a budget of 100 stations, and 22 locations, against a benchmark genetic algorithm.

4 - An Operations Research Game on the iOS Platform
Meltem Ozmadenci, Lehigh University, 200 W Packer Ave., Mohler Laboratory, Bethlehem, PA, 18015, United States of America, meltemozmadenci@gmail.com, Lawrence V. Snyder

We have built an iPad application which demonstrates classical OR problems, explored in the context of a restaurant business game. The game has several sections modeling different problem types such as Facility Location and Traveling Salesman. The user faces versions of these problems in increasing difficulty, unlocking successive levels by finding optimal solutions. In this talk, we will demonstrate the app and discuss how it can be used to teach OR concepts.

■ SC27

Level 2 - Room 209A

Joint Session (MAS/HAS/DAS): Decision Making in Military Healthcare

Sponsor: Military Applications, Health Applications, & Decision Analysis

Sponsored Session

Chair: Nathaniel D. Bastian, PhD Student | Captain, The Pennsylvania State University, United States Army, 355 Leonhard Building, University Park, PA, 16802, United States of America, nathaniel.bastian@fulbrightmail.org

Co-Chair: Lawrence V. Fulton, Assistant Professor, Texas State University, 601 University Drive, San Marcos, TX, 78666, United States of America, lf25@txstate.edu

1 - Performance Measurement of the Military Health System: A Multi-Objective Approach
Nathaniel D. Bastian, PhD Student | Captain, The Pennsylvania State University, United States Army, 355 Leonhard Building, University Park, PA, 16802, United States of America, nathaniel.bastian@fulbrightmail.org, Lawrence V. Fulton

Senior leaders within the Military Health System want to analyze how system inputs and outputs can be optimized to improve healthcare resource allocation decisions while balancing costs, quality and access. Therefore, this work proffers an optimization model that adjusts resources automatically across all military medical treatment facilities to achieve maximum system efficiency, which provides decision-support and insight for leaders interested in evaluating multiple objectives simultaneously.

2 - Decision Support for Selecting the Future Medical Evacuation Aircraft

Lawrence V. Fulton, Assistant Professor, Texas State University, 601 University Drive, San Marcos, TX, 78666, United States of America, lf25@txstate.edu, Nathaniel D. Bastian

We demonstrate the use of stochastic optimization in providing cost effectiveness analysis for selection of the military's future, in-theater aeromedical evacuation vehicle. Given the uncertain nature of future conflict, evaluating trade-offs over multiple scenarios is of increasing importance to decision-makers. To demonstrate the utility of optimization, we provide an analysis of current and emerging technology over scenarios that have varying risk and complexity.

3 - Multi-stage Deployment of the Army Theater Hospital

Trisha Cobb, Naval Postgraduate School, 1 University Circle, Monterey, CA, 93943, United States of America, tacobb@nps.edu, Nedialko Dimitrov

A conflict can change overtime from full combat operations, to insurgency suppression, to local force training. Each of these conflict types requires an Army Theater Hospital to handle inflows of different types of patients—soldiers, civilians, children, and elderly—at different rates. This study analyzes the configuration of an agile Army Theater Hospital that can adapt to changing conflict through modular asset deployment.

4 - Vietnam Veteran Mortality

Matthew S. Brooks, Texas State University, 601 University Drive, San Marcos, TX, 78666, United States of America, mb96@txstate.edu

Increased early mortality in Vietnam Veterans is going unnoticed and deserves analysis. Examine veteran deaths in the Social Security Administration Death File. The Vietnam Veteran is seeing a significantly different distribution of deaths than the population. A simple graphical comparison illustrates that the majority of Vietnam Veterans who died were younger (mode 50-55) vs. the population (mode of 75 or greater). All cause mortality among the Vietnam Veteran cohort is higher than expected.

■ SC28

Level 2 - Room 209B

Joint Session Doing Good/SPPSN: Doing Good with Good OR II

Cluster: Doing Good with Good OR & Public Programs, Service and Needs

Invited Session

Chair: Laura McLay, Associate Professor, University of Wisconsin-Madison, Industrial & Systems Engineering, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - Doing Good with Good OR - Student Paper Competition

Jérémie Gallien, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, jgallien@london.edu

Doing Good with Good OR - Student Paper Competition is held each year to identify and honor outstanding projects in the field of operations research and the management sciences conducted by a student or student group that have a significant societal impact.

2 - Redesign of the Dispatching System for the Santiago Fire Department

Alvaro Echeverria, Universidad de Chile, Industrial Engineering Department, Santiago, Chile, Renaud Chicoisne, Daniel Espinoza, Fernando Ordonez

Response time is a key indicator of the effectiveness of a fire department. We developed a new dispatching system based on minimum expected travel time that considers congestion estimated from GPS transit data. An efficient reverse Dijkstra using binary heaps is implemented, in addition to a web-interface to facilitate adoption. The Santiago Fire Department reports a 1min reduction since deployment.

3 - Internal Medicine Residency Scheduling at the University of Illinois, Urbana-Champaign College of Medicine

David Morrison, University of Illinois, Urbana-Champaign, 201 N. Goodwin Ave., Urbana, IL, United States of America, morris50@illinois.edu

The residency scheduling problem (RSP) is faced by hospitals around the country; medical residents must be assigned to rotations to satisfy coverage constraints and other side constraints. Currently, no prescriptive computational tools exist to aid in schedule generation; thus, schedules are created by hand. This project describes RESIDENT, the first computational tool to solve RSP, using integer programming techniques.

4 - Improving a Recommender System for Child Adoptions

Vincent Slaugh, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15208, United States of America, vslaugh@cmu.edu

We utilize an operations research framework to improve the effectiveness of a recommender system for children in state custody and adoptive families. Through a spreadsheet tool and managerial insights that have led to process redesigns, we have addressed key challenges related to the quality of the system's information, the value of the recommendation algorithm, and the interaction among system participants.

■ SC29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Palisade Corporation-Avoiding Failure: Using @RISK to Identify, Analyze and Manage Risk More Successfully

Rafael Hartke, Palisade Corporation, 798 Cascadilla St., Ithaca, NY, 14850, United States of America, rhartke@palisade.com

Projects fail. They often fail for a lack of effective planning, either because of excess optimism in terms of time, cost and performance or because of extra work in the plan in terms of scope, resources and unforeseen events. @RISK employs Monte Carlo based simulation to give insight through sophisticated statistical analysis of the various potential outcomes. Understanding range outcomes facilitates effective risk management, prioritizing critical risks and managing expectations.

2 - LINKS Simulations - Exploiting Web Resources for Maximum Teaching and Learning Impact with Integrative Competitive Simulations

Randall G. Chapman, LINKS Simulations, Winter Garden, FL, United States of America, chapman@LINKS-simulations.com

How can an instructor teach effectively and efficiently with an integrative, large-scale, team-based, competitive business/management simulation? By exploiting the simulation's web-based teaching and learning resources! This presentation explores web-based resources for supporting instructors and their students throughout LINKS simulations events.

■ SC30

Level 2 - Room 210B

Workforce Planning with Learning

Cluster: Workforce Engineering and Management

Invited Session

Chair: Scott Grasman, Professor and Head, Rochester Institute of Technology, Industrial and Systems Engineering, 81 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, Scott.Grasman@rit.edu

1 - Workforce Planning with Training and Learning

Huan Jin, University of Iowa, Iowa City, IA, 52241, United States of America, huan-jin@uiowa.edu, Barrett Thomas

Training is an effective way to expand workforce capacity using existing resources. Yet, incorporating the effects of training into optimization models that explicitly account for the effects of training on human learning complicates an already nonlinear integer program. We linearize the model via reformulation and develop a solution approach to overcome the significant increase in constraints and integer variables. Our results demonstrate the value of explicitly modeling training.

2 - Reformulation Techniques for Solving Non-linear Workforce Planning Models with Learning

Mike Hewitt, Assistant Professor, Loyola University Chicago, 1 E. Pearson, Chicago, IL, 60611, United States of America, mrheie@rit.edu, Scott Grasman, Austin Chacosky, Barrett Thomas

The literature on human learning suggests that quantitative, descriptive models of human learning are non-linear. As a result, prescriptive planning models are difficult to solve. We present a reformulation technique that models non-linear learning functions with sets of binary and linear variables and constraints. With this technique, we are able to solve problems in reasonable runtimes that are significantly larger than what has been previously possible.

3 - Workforce Cross-training with Learning
Scott Grasman, Professor and Head, Rochester Institute of Technology, Industrial and Systems Engineering, 81 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, Scott.Grasman@rit.edu

This work develops cross-training frameworks that incorporate worker learning. A mathematical modeling framework is presented along with key insights from the solution of practical cases. These insights lead to policies for workforce development.

■ SC31

Level 2 - Room 211A

Quantitative Financial Risk Management

Sponsor: Financial Services

Sponsored Session

Chair: Samim Ghamami, University of California-Berkeley, Berkeley, CA, United States of America, samim_ghamami@berkeley.edu

1 - Optimal Timing for Mean Reversion Trading
Tim Leung, Assistant Professor, Columbia University, IEOR Department, 500 West 120th Street MC4704, New York, NY, 10027, United States of America, tl2497@columbia.edu, Xin Li

We discuss the optimal timing to trade under mean-reverting price dynamics subject to transaction cost. We formulate an optimal double stopping problem to analyze the optimal timing to enter and subsequently exit the market, when prices are driven by an Ornstein-Uhlenbeck (OU), exponential OU, or Cox-Ingersoll-Ross (CIR) process.

2 - Asymptotic Comparison of Popular Approaches to Pricing Bermudan Options
Sandeep Juneja, Professor, Tata Institute of Fundamental Research, HB Road, Colaba, Mumbai, 400005, India, juneja@tifr.res.in, Ankush Agarwal

We consider two phase implementations for pricing Bermudan options of least squares, stochastic mesh and nearest neighbor method. We discuss optimal computational budget allocation between two stages in these methods and identify the asymptotic convergence rate of the estimator mean square error under optimal budget allocations. We compare and contrast the strengths and weaknesses of these methods.

3 - Occupation Times, Drawdowns and Drawups for One-dimensional Regular Diffusions
Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave., 928, New York, NY, 10027, United States of America, hz2244@columbia.edu

Motivated by the omega risk model, we consider a diffusion type, reduced form default model where the hazard rate depends on the level or the drawdown of the underling process, using which we calculate the probability of observing a large drawdown before the actual default occurs. The derivation is through computing a class of stopped occupation time formulas for regular diffusions. Other applications of the result include pricing of Parisan-like and alpha-quantile options on the drawdown.

■ SC32

Level 2 - Room 211B

New Product Development

Sponsor: Technology Management

Sponsored Session

Chair: Debasish N. Mallick, Associate Professor, University of St. Thomas, Opus College of Business, 1000 LaSalle Ave. #SCH 435, Minneapolis, MN, 55403, United States of America, dnmallick@stthomas.edu

1 - Improving the Systems Engineering Process with Multi-Domain Mapping
Nitin Joglekar, Boston University, 595 Commonwealth Avenue, Boston, MA, 02215, United States of America, joglekar@bu.edu, Terence Teo, Steven Eppinger, Alison Olechowski

Multi domain development decisions (e.g. dependencies across system architecture and integration task domains) can be assessed using the DSM method. Data collected during early development stage of a large engineering project are used to construct a domain mapping matrix (DMM). Analysis of this matrix, using alternative metrics, facilitates the visualization of integration challenges for individual components within the system and establishes the efficacy of various integration testing tasks.

2 - The Future of New Product Development
Sebastian Fixson, Babson College, Tomasso 226, Babson Park, United States of America, sfixson@babson.edu

We explore how technological advancements in digital technologies such as digital design and rapid prototyping, together with a shift towards a sharing culture, are altering the nature of new product development processes with respect to participation, ownership, and the locus of expertise. Using a set of case studies we investigate new emerging models of new product development, and illustrate the consequences for managing them.

3 - Do Gurus Breed Gurus? An Analysis of Collaboration in Design
Haibo Liu, PhD Candidate, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, HAIBO.Liu@insead.edu, Manuel Sosa, Jurgen Mihm

Understanding the emergence of gurus is critical because gurus make disproportional contributions to their fields. We empirically pin down the mechanisms by which collaborating with gurus affect the propensity of becoming a guru. In light of our findings, we suggest reevaluate the effect of knowledge transfer in collaborations along with the effect of attention transfer. We test our predictions using Event History Analysis on a large longitudinal dataset derived from design patents in U.S..

4 - New Product Development (NPD): Impact of Design-Manufacturing Interface
Debasish N. Mallick, Associate Professor, University of St. Thomas, Opus College of Business, 1000 LaSalle Ave. #SCH 435, Minneapolis, MN, 55403, United States of America, dnmallick@stthomas.edu

We explore the issues at the interface between design and manufacturing activities and examine how these issues impact the new product development performance.

■ SC33

Level 2 - Room 211C

Capacity Management for Passenger Train Service (RAS Roundtable Part 1)

Sponsor: Railway Applications

Sponsored Session

Chair: Carl VanDyke, Partner, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, Carl.VanDyke@oliverwyman.com

1 - Creating Network Capacity through Operational Changes
David Hunt, Senior Specialist, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08550, United States of America, david.hunt@oliverwyman.com, Marc Meketon

If costs were not an issue, adding more rail track would be an easy solution to increasing line capacity. Since costs are always an issue, rail planners have become very creative when faced with a corridor that is near or at capacity. This presentation will discuss the expected gain in capacity for various non-infrastructure options, provide some thoughts on how to select between the options, and explore how these options impact efforts to define and model rail capacity.

2 - Line Capacity Modeling Techniques and Tools
Steven Harrod, Assistant Professor, University of Dayton, 1143 Ashburton Dr., Dayton, OH, 45459, United States of America, a2soft@aol.com

Line capacity models either estimate the maximum number of train paths for a given network or the timetable robustness for a given train volume. Methods are further divided by whether most trains run to a timetable, or are unscheduled. This presentation will review parametric, optimization, and simulation approaches.

3 - Screening Capacity Analysis for Preliminary Passenger Rail Planning
Edwin R "Chip" Kraft, TEMS, Inc., 116 Record Street, Frederick, MD, 21701, United States of America, ckraft@temsinc.com

A recent TRB study developed a new methodology for estimating capacity needs for adding passenger trains to a freight rail line. This involves developing a passenger schedule, then adding freight trains to identify conflicts. Infrastructure needs can then be estimated. This first step gives planners an approximate estimate of the infrastructure need. This presentation describes this methodology and its role in the capacity planning process.

4 - Northstar – Planning Passenger Capacity on a Freight Rail Corridor

Jan Ruby, Northstar Suburban Terminal Manager, BNSF, 19699 Co. Road 43, Big Lake, MN, 55309, United States of America, Jan.Ruby@bnsf.com

Northstar, a commuter rail operator in Minneapolis, has to plan and execute its schedule on an active freight corridor. Success involves development of a long term operating plan coordinated with BNSF, the freight operator, long before the service is launched. The parties must also maintain a close working relationship to facilitate regular service planning. This presentation will focus on how BNSF and Northstar have cooperated to develop and maintain a plan that meets the needs of everyone.

■ SC34

Level 2 - Room 211D

Applications of Optimal Learning

Sponsor: Simulation Society

Sponsored Session

Chair: Peter Frazier, Assistant Professor, Cornell University, School of ORIE, Rhodes Hall, Ithaca, NY, United States of America, pf98@cornell.edu

1 - Optimal Learning with Local Parametric Models

Bolong Cheng, Princeton University, Sherrerd Hall, Princeton, NJ, 08540, United States of America, bcheng@princeton.edu, Warren Powell

We are interested in maximizing a general function where observations are noisy and may be expensive. We derive a knowledge gradient policy, which chooses measurements which maximize the expected value of information, while using a locally parametric belief model which uses linear approximations with radial basis functions. Our technique accounts for correlation within adjacent subsets of the alternatives and does not pose any a priori assumption on the global shape of the underlying function.

2 - Efficient Learning of Donor Retention Strategies for the American Red Cross

Bin Han, University of Maryland, College Park, MB, United States of America, danielh@umd.edu, Ilya Ryzhov, Boris Defourny

We present a new sequential decision model for allocating campaign budget for the American Red Cross. The outcome—attributes relation is modeled using linear regression. We derive the first simulation procedure for learning unknown regression parameters and sampling noise. We apply convex approximation with a quantization procedure and semidefinte programming relaxation to reduce the computational complexity. Simulation experiments demonstrate the efficient performance of the approximation.

3 - Exploration vs. Exploitation in the Information Filtering Problem

Xiaoting Zhao, Cornell University, Ithaca, NY, 14850, United States of America, xz337@cornell.edu, Darlin Alberto, Peter Frazier

In information filtering, a computer filters irrelevant items from a stream of information too voluminous to process by hand (e.g., scientific papers, blog posts, satellite photos). Such systems face the exploration vs. exploitation tradeoff, in which it may be beneficial to present an item that is likely to be irrelevant, because feedback allows the system to learn and improve. We present an analysis of this problem using stochastic dynamic programming, and an application to the arXiv.

■ SC35

Level 2 - Room 212A

Frontiers of Social Media and Crowdsourcing

Sponsor: E-Business

Sponsored Session

Chair: Akhmed Umyarov, University of Minnesota, 321 19th Ave. S. #3-376, Minneapolis, MN, United States of America, aumyarov@umn.edu

1 - Maximizing Employer's Utility in Online Labor Markets

Marios Kokkodis, PhD Student, New York University, Stern School of Business, New York, NY, United States of America, mkokkodi@stern.nyu.edu, Panagiotis Ipeirotis, Panagiotis Papadimitriou, Yiannis Antonellis

In this work we study the matching problem in online labor markets (OLMs) by concentrating on the employer's side; we assume that employers make rational decisions and that they are utility maximizers. Under reasonable assumptions, we define the employer's utility as a function of the probability of hiring a particular worker and the inferred quality of the worker. We build and evaluate our models on real transactional data from one of the leadings OLMs, oDesk.com.

2 - Conspicuous Consumer Purchases in a Social Media Context

Lauren Rhue, PhD Candidate, New York University Stern School of Business, 44 West 4th St., KMC 8-186, New York, NY, 10012, United States of America, lrhue@stern.nyu.edu, Arun Sundararajan

The visibility afforded by social media generates anticipatory social externalities that shape consumer purchase patterns and preferences. Evidence suggests that social media encourages consumers to diversify their portfolio of conspicuous purchases. Furthermore, the responses to consumer posts are shaped by the existing social network ties and mold the consumer's norms.

3 - An Empirical Examination of Online Information Hiding in a Crowdfunding Context

Gordon Burtch, Assistant Professor, University of Minnesota, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, burtc002@umn.edu, Anindya Ghose, Sunil Wattal

We leverage large-scale proprietary data from a major crowdfunding platform to examine users' decisions to conceal contributions from public view. We find that this is more likely when users are privacy sensitive, under greater scrutiny or exhibiting "extreme" behavior. We also find evidence of an anchoring effect, which is eliminated when prior amounts are concealed. This is only beneficial when those amounts are small, so we discuss more nuanced approaches to the design of privacy controls.

4 - App Economy: Understanding Demand for Bestselling Apps on Mobile Platform

Rajiv Garg, Carnegie Mellon University, 4800 Forbes Ave., Pittsburgh, PA, 15213, United States of America, rg@cmu.edu

Smartphones and tablets have created a new market, which is highly dynamic with large volume of sales and consumption of software applications. We present a simple framework to use only publicly available data to infer rank-demand relationship for bestselling apps. With the sales-rank relationship we estimate the price elasticity for both iPhone and iPad platforms and present the impact of app characteristics on their demand.

■ SC36

Level 2 - Room 212B

OR in Vaccine Design and Pandemic Preparedness

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Mario Ventresca, University of Toronto, 5 King's College Rd., Toronto, Canada, mario.ventresca@utoronto.ca

1 - Modeling the Effect of Transients on Flu Epidemics in Washington, D.C.

Mina Youssef, Postdoctoral Research Associate, Network Dynamics and Simulation Science Laboratory, Virginia Bioinformatics Institute, Virginia Tech, 1880 Pratt Drive, Research Building XV, Blacksburg, VA, 24061, United States of America, mkamel@ksu.edu, Samarth Swarup, Stephen Eubank, Nidhi Parikh

We build a synthetic population model of transient and resident populations in Washington DC and study the impact of transients on flu epidemics. We focus interventions on reducing disease spread in major tourist destinations, which can have 80,000 visits per day. Surprisingly, promoting practices to reduce disease spread (such as hand sanitizer use) is more effective than closing down the museums entirely. We also present an explicit form of the reproductive number and a stability analysis.

2 - Ranking Pandemic Interventions via Multilevel Sensitivity Analysis of Model Results

Patrick Finley, Complex Systems Engineer, Sandia National Laboratories, PO Box 5800 MS 1198, Albuquerque, NM, 87110, United States of America, pdfinle@sandia.gov, Thomas Moore, Greg Lambert, Leland Evans, Richard Martinello, Carter Mecher, Robert Glass, Victoria Davey

Multilevel sensitivity analyses (SA) of pandemic disease models are used to rank potential mitigation strategies. Novel SA methods based on weighted Levenschtein-edit distances, penalized multinomial logistic regression, and stochastic dominance of Gaussian process surfaces produce mitigation effectiveness rankings which vary in response to demographic and contact-network parameters. If the ranking criterion is changed from total infected to $/QALY, intervention strategy rankings also change.

3 - Optimal Design of the Annual Influenza Vaccine with Manufacturing Autonomy

Osman Ozaltin, Assistant Professor, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, oozaltin@uwaterloo.ca, Andrew Schaefer, Oleg Prokopyev

Seasonal influenza is a major public health concern, and the first line of defense is the flu shot. We propose a bilevel multi-stage stochastic mixed-integer program that maximizes societal benefit of the flu shot under autonomous profit maximizing manufacturers. Calibrated over publicly available data, our model returns the optimal flu shot composition and timing in a stochastic and dynamic environment. We derive analytical results, and perform extensive numerical experiments.

4 - Optimization Models to Control Infectious Disease Spread in Networks

Apurba Nandi, Graduate Research Assistant, Mississippi State University, 1000 Campus trails Apt. 151, Starkville, MS, 39759, United States of America, akn77@msstate.edu, Hugh Medal

Minimizing the spread of an infectious disease in a network using limited resources is a challenging problem. We describe several mixed-integer programming models that seek to minimize the expected number of new infections during an outbreak by strategically removing links. Then, we compare the results of our models with those of an existing optimization model. Finally, we develop an algorithm to solve larger problems and show that it outperforms two well-known link selection heuristics.

■ SC37

Level 2 - Room 213A

Patient Flow: Hospitals and Beyond

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Jonathan Helm, Indiana University, 1309 E. 10th St., Bloomington, IN, United States of America, helmj@indiana.edu

1 - A Capacity Reservation Scheme for Outpatient Scheduling at the Mayo Clinic

Jivan Deglise-Hawkinson, University of Michigan, Ann Arbor, MI, United States of America, jivan@umich.edu, Jonathan Helm, Todd Huschka, David Kaufman, Thomas Rohleder, Mark Van Oyen

Mayo Clinic currently uses a decentralized approach to reserve appointment capacity for different types of patients. This often results in blocking for internal referral visits between medical departments and in less than desired access to care for some patients. Our capacity planning model optimizes a booking plan that allows proper access by patient type, accounts for physicians' preferences, and forecasts patients' future resource needs in each department to reduce internal blocking.

2 - Overflow Policies for ED Patients Awaiting Inpatient Beds

Pengyi Shi, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, pengyishi@gatech.edu, Jim Dai

Emergency department (ED) patients who wait to be admitted to inpatient beds sometimes have to be overflowed to a non-primary ward after their waiting time exceeds a certain threshold. We study a two-class, two-server-pool queueing system to gain insights into the impact of overflow policies on system performance. We show analytical results for systems with two special overflow policies and discuss the impact of several factors (such as bed capacity and discharge timing) on the overflow rate.

3 - Cost Sensitive Inpatient-ward Bed Reservation Model for Emergency Department Triage

Shanshan Qiu, Wayne State University, Detroit, MI, United States of America, shanshan@wayne.edu, Alper Murat, Ratna Babu Chinnam

Research has suggested that if hospital admissions of ED patients can be predicted during triage with confidence, proactive inpatient-ward bed requests can be triggered early on to reduce patient boarding. We propose a cost sensitive bed reservation policy that optimally manages bed reservations for patients. Our results from using EDIS data of Detroit VAMC indicate significant cost saving potential and reduced boarding under the proposed bed reservation policy.

4 - Capacity Planning for Cancer Prevention

Aaron Ratcliffe, University of North Carolina at Chapel Hill, CB 3490, Chapel Hill, NC, 27514, United States of America, Aaron_Ratcliffe@unc.edu, Ann Marucheck, Wendell Gilland

We analyze a queuing network to study the relationship between screening guidelines and capacity planning for colorectal cancer. The screen provider chooses its capacity to balance the cost of cancer detection delay with the cost of additional capacity. Patients spend a random time at home before scheduling a repeat screen. We consider the impact of other provider interventions such as price changes and education efforts about screening guidelines.

■ SC38

Level 2 - Room 213B

The Role of Human Interactions in MCDM

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Hannele Wallenius, Professor and Department Head, Aalto University School of Science, POB 11000, 00076 Aalto, Espoo, Finland, Hannele.Wallenius@aalto.fi

1 - Impact of Different Interaction Patterns and Human Inconsistencies on Hybrid Evolutionary Multi-Objective Algorithm

John Fowler, Professor and Department Head, Arizona State University, School of Business, Tempe, United States of America, John.Fowler@asu.edu, Esma Gel, Jyrki Wallenius, Pekka Korhonen, Jone Marquis, Murat Koksalan

We investigate the impact of inconsistent DM responses and different interaction patterns on the convergence of an interactive, evolutionary multi-objective algorithm developed by authors. As test problems we use 2-4 objective knapsack problems, multi-criteria scheduling problems, and multi-objective facility location problems. The results indicate that the algorithm is robust to minor inconsistencies in DM responses. There is also surprising robustness towards different interaction patterns.

2 - An Interactive Algorithm for Multi-objective Integer Programs

Jyrki Wallenius, Aalto University School of Business, Runebergink. 14-16, Helsinki, Finland, jyrki.wallenius@aalto.fi, Murat Koksalan, Pekka Korhonen, Banu Lokman

We develop an interactive algorithm for multi-objective integer programs under an underlying quasiconcave value function. We generate constraints to eliminate inferior regions with respect to the convex cones derived from past preferences. We also develop a variation that approximates the most preferred solution with a desired level of accuracy. Our computational results show that it performs well in terms of the solution quality, solution time, and required preference information.

3 - On the Linear Transformation of Multiple Criteria Vectors

Pekka Korhonen, Professor, Aalto University School of Business, POB 21210, 00076 Aalto, Helsinki, Finland, Pekka.Korhonen@aalto.fi, Abolfazl Keshvari

We study properties of the linear transformation of multiple criteria vectors in evaluation problems. In case of a non-singular transformation, no information is lost provided we transform the efficient frontier accordingly. The singular transformation is more complicated. Not all transformations are feasible. We discuss the principles and propose a method for a proper transformation. Numerical illustrations are used.

4 - Multi-objective Model to determine the Location of a Food Factory

Markku Kuula, Professor, Aalto University School of Business, POB 11000, 00076 Aalto, Helsinki, Finland, markku.kuula@aalto.fi, Antero Putkiranta, Ville Hallavo

Infrastructure of the current factories of a Finnish food company will come to the end of their life cycles within the next 10 years. In this paper the optimal location for the future factories are estimated and the optimal value chain; animal production – butchery – processing – warehousing – distribution are defined. Decisions are based on multiple objectives, such as the consumer expectations, transportation costs and investment and operating costs of the animal production plants.

■ SC39

Auditorium 3

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - MOSEK ApS - On Using MOSEK to Solve Large-Scale Linear and Conic Optimization Problems

Erling Andersen, CEO, MOSEK ApS, Fruebjergvej 3, Box 16, DK-2100, Copenhagen, Denmark, e.d.andersen@mosek.com

MOSEK is a tool for solving large scale potentially mixed-integer linear and conic optimization problems. In this demonstration we will introduce MOSEK and demonstrate how to call MOSEK from mainstream languages such as C, MATLAB, Java, .NET and Python.

2 - Ivy Software Inc. - Quantitative Pre-Matriculation Materials for MBA Programs

Rob Holt, Marketing Representative, Ivy Software, Inc., PO Box 15776, Richmond, VA, 23227, United States of America, rob@ivysoftware.com

Ivy Software will present three online courses, Business Math and Statistics, Math and Statistical Concepts, and Excel for MBAs. In addition, Ivy will present Excel for undergraduate business majors. Each course consists of a text and interactive software. The courses are self-paced, online and utilize extensive assessment testing. Topics covered are regression, probability and decision analysis. Our new courses will run on PC, Mac and iOS.

■ SC40

Auditorium 2

Procurement Auctions and Market Design

Cluster: Auctions

Invited Session

Chair: Gabriel Weintraub, Columbia Business School, Uris Hall 402, New York, NY, United States of America, gyw2105@columbia.edu

1 - Iterative Auctions for General Graphical Valuations

Ozan Candogan, Duke University, Fuqua School of Business, Durham, NC, United States of America, candogan@mit.edu, Asuman Ozdaglar, Pablo Parrilo

Multi-item iterative auctions are commonly employed in practice, for instance, in the context of spectrum and procurement auctions. However, existing efficient iterative auction formats either do not allow for value complementarity between different items, or they require complex pricing structures. In this work, we focus on graphical valuations and develop new practical and efficient iterative auctions for multi-item settings that exhibit both value complementarity and substitutability.

2 - Promoting Competition in Procurement Mechanisms

Gabriel Weintraub, Columbia Business School, Uris Hall 402, New York, NY, United States of America, gyw2105@columbia.edu, Daniela Saban

In this talk we discuss recent work that studies effective mechanisms to enhance competition in procurement settings and reduce buying prices. Portions of this work have been done in collaboration with the Chilean government procurement agency, in charge of buying US$9.1 billion worth of products and services every year.

3 - Field Experiment in B2B Auctions

Wedad Elmaghraby, Associate Professor, University of Maryland, RH Smith School of Business, Van Munching Hall Room 4352, College Park, MD, 20742-1815, United States of America, wedad_elmaghraby@rhsmith.umd.edu, Anand Gopal, Ali Pilehvar

Although product assortment problem has received plenty of attention in the marketing and operations literature in recent years, it is yet unexplored in the auction literature. We report on the results of a field experiment that we ran on the auction site of one of the nation's largest online auction wholesale liquidation sites. The field experiment was aimed at understanding how the number of auctions, the assortment of products and the starting price of an auction impact the final price.

4 - Computational Bundling for Auctions

Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15232, United States of America, sandholm@cs.cmu.edu, Christian Kroer

Optimal multi-item auctions impractically favor some bidders and randomize. Instead, we study a revenue-enhancement approach - bundling - in VCG. The prior can be doubly exponential. Instead, many applications have an inaccurate point prior. We adopt this model, and prove robustness to inaccuracy. Then we present a branch-and-bound framework for optimal bundling. We introduce techniques for branching, upper and lower bounding, and lazy bounding. Experiments show dramatic improvement over CPLEX.

■ SC41

Level 1 -101A

Models in Retail Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Victor Martínez de Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu

1 - A Closed-loop Approach to Dynamic Assortment Planning

Victor Martínez de Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu, Esra Cinar

Firms offering short-lived products are constantly trying to keep the customers interested by refreshing their assortments. We model these dynamics by assuming that products lose their attractiveness over time and we let the firm enhance the assortment at a cost, e.g., with new product introductions. We characterize the optimal closed-loop policy that maximizes the revenue obtained by increasing the attractiveness of an assortment, minus the associated cost of the adjustments.

2 - Adoption of a Markdown Decision Support System at Zara

Felipe Caro, University of California-Los Angeles, Anderson School of Business, Box 951481, B420 Gold Hall, Los Angeles, CA, 90095-1481, United States of America, fcaro@ucla.edu

Since 2008, Zara has been using a model-based process to support its markdown decisions during clearance sales. We study the adoption of the tool by the country managers and analyze the impact that key user interface modifications have had on pricing decisions.

3 - Dynamic Clustering and Assortment Personalization

Denis Saure, University of Pittsburgh, Pittsburgh, United States of America, dsaure@pitt.edu, Sajad Modaresi

We study the problem of a retailer facing heterogeneous consumers with initially unknown preferences. The retailer might customize offerings based on available profile information. However, users with different profiles might behave identically, suggesting that no all information is relevant. Thus, the retailer might benefit from pooling customers with similar behavior. We propose policies that dynamically adjust customer segmentation to maximize cumulative revenue.

4 - Bundling Strategies for Vertically Differentiated Products

Dorothee Honhon, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, D.B.L.P.Honhon@tue.nl, Xiajun Amy Pan

We consider a retailer selling vertically differentiated products which can be offered individually or as part of a bundle in order to maximize profits. We show that the optimal bundling strategy can be pure bundling, mixed bundling or pure components depending on the quality relationship between the products and component scarcity.

■ SC42

Level 1 -101B

The Impact of Government Environmental Regulations on Supply Chains

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Gal Raz, Associate Professor, University of Virginia, Darden Business School, 100 Darden Blvd., Charlottesville, VA, 22903, United States of America, Razg@darden.virginia.edu

1 - Coordinating Pricing and Supply of Public Interest Goods using Rebates and Subsidies

Gal Raz, Associate Professor, University of Virginia, Darden Business School, 100 Darden Blvd., Charlottesville, VA, 22903, United States of America, Razg@darden.virginia.edu, Anton Ovchinnikov

This paper presents a framework for analyzing the impact of demand uncertainty and consumption externality on the government's ability to coordinate the pricing and supply of public interest goods (such as electric vehicles) through the use of rebates and subsidies. We show that while a joint mechanism (using both subsidies and rebates) coordinates the system (but may often result in negative subsidy - a tax), simplified mechanisms (i.e., rebates or subsidy) do not coordinate the system.

2 - The Impact of Supplier Pricing on Manufacturers' Replacement of a Substance of Concern

Tim Kraft, Assistant Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, kraftt@darden.virginia.edu, Gal Raz

In this paper we analyze how a supplier can influence the adoption of a replacement for a substance of concern. We consider the impact of the existing regulatory threat, market sensitivity, and supplier price. As extensions we consider: 1) a scenario where firms can collaborate to replace the substance and 2) a setting in which the supplier first targets an alpha customer before offering the replacement to the entire industry.

3 - Recovery Legislations versus Taxation/Subsidy Policies for Product Remanufacturing

Shumail Mazahir, PhD Candidate, HEC Paris, Campus HEC, 1 rue de la libération, Jouy en Josas, France, shumail.mazahir@hec.edu, Sam Aflaki

This paper studies the effect of incorporating recovery/remanufacturing targets on the performance of firms and compares them with incentive schemes such as taxation/subsidy policies. We characterise conditions under which the two types of policies outperform each other in terms of prices, manufactured and recovered quantities etc.

■ SC43

Level 1 -101C

Social Interactions and Operations Management I

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, M5S 3E6, Canada, Ming.Hu@Rotman.Utoronto.Ca

1 - Bayesian Social Learning with Consumer Reviews

Bar Ifrach, Postdoctoral Researcher, Stanford University, Huang Engineering Center Room 258, 475 Via Ortega, Stanford, CA, 94305, United States of America, bifrach@stanford.edu, Costis Maglaras, Marco Scarsini

We study a market with heterogeneous customers who rationally learn the quality of an offered product by observing the reviews of customers who purchased the product earlier in time. We explore aspects of this social learning process such as: its success in revealing the true quality over time, and the effect of the order in which reviews are submitted on consumers' beliefs. In addition, we draw conclusions on the seller's pricing problem when accounting for social learning.

2 - Optimal Pricing in the Presence of Social Learning and Forward-Looking Consumers

Yiangos Papanastasiou, London Business School, Regent's Park, London, United Kingdom, yiangosp.phd2010@london.edu, Nicos Savva

When a new product of uncertain quality is introduced to the market, consumers may choose to delay their purchasing decision in anticipation of social learning from the reviews of early buyers. This paper studies the problem of optimal dynamic pricing when a monopolist operates in such an environment. We analyze and compare two types of pricing policies, pre-announced and contingent, and identify their implications for consumer surplus and firm profit.

3 - Preferences, Homophily, and Social Learning

Evan Sadler, NYU Stern School of Business, 44 W 4th Street, 8-154K, New York, NY, 10012, United States of America, esadler@stern.nyu.edu, Ilan Lobel

We study homophily in a Bayesian model of social learning. Prior theory finds that diverse preferences are beneficial, while homophily slows learning. However, this conflicts with empirical findings. We explain the discrepancy in terms of network density. Our model agrees with existing theory and with empirical findings when networks are dense and sparse respectively. Further results suggest that homophily is unlikely to impede learning and can be beneficial in networks with dense components.

■ SC44

Level 1 -101D

Topics in Retailing

Sponsor: Manufacturing & Service Operations Management/ Supply Chain

Sponsored Session

Chair: Fernando Bernstein, Professor, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, fernando.bernstein@duke.edu

1 - Informative Product Demonstrations and Prices

Haresh Gurnani, Professor, University of Miami, Department of Management, Coral Gables, FL, 33124, United States of America, haresh@miami.edu, Ralph Boleslavsky, Chris Cotton

Firms use product demonstrations to educate prospective retail consumers about product valuation. While more informative demonstrations reduce valuation risk, it may reduce competition and make consumers worse off. This has important implications for firm profits, consumer protection, and for better understanding the release of "niche" products with uncertain customer appeal.

2 - Holiday Retailing with Gift Cards

Alice Lu, University of Pennsylvania, Univesity of Pennsylvania, Philadelphia, PA, United States of America, xingwei@wharton.upenn.edu, Xuanming Su

Using gift cards, holiday gift givers can avoid offering an unwanted gift, but recipients incur the hassle of redeeming the gift card and may not find what they want. We study the profitability of gift cards and explore novel gift card policies.

3 - Signaling Quality via Stock-outs

Laurens Debo, Associate Professor, University of Chicago, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu, Garrett van Ryzin

When some consumers are uncertain about a product's quality, product availability conveys information about the propensity of other, better-informed, consumers to purchase. The willingness-to-pay of less-informed consumers may therefore increase after observing a stock-out. We develop a model in which the firm can harvest the increased willingness-to-pay after a stock-out via its pricing strategy later in the season.

4 - Using Dynamic Assortments to Induce Purchases from Strategic Consumers

Fernando Bernstein, Professor, Duke University, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, fernando.bernstein@duke.edu, Victor Martinez de Albéniz

Retailers of short-life-cycle products update their offerings periodically to induce frequent visits to their stores. These in-season introductions are well-known by consumers. We provide a model of decision making for designing dynamic assortments when customers are forward-looking and may substitute consumption across periods. We show that myopic customers always make their purchase earlier than strategic customers. We next explore the retailer's optimal assortment rotation policy.

■ SC45

Level 1 -101E

The Role of Regulation on Environmental Sustainability

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Eda Kemahlioglu-Ziya, UNC-Chapel Hill, CB 3490, Chapel Hill, NC, United States of America, eda_kemahliogluziya@unc.edu

1 - Cooperation for Sustainability

Fang Tian, Ph.D. Candidate, University of Southern California, Marshall School of Business, IOM Department, BRI 401, Los Angeles, CA, 90089-0809, United States of America, tianfang@usc.edu, Marco Slikker, Greys Sosic

We consider the Design for Environment (DfE) setting and study manufacturers who cooperate by sharing their technology for product design and manufacture in order to improve products' recyclability. We discuss the incentives that could facilitate manufacturers' cooperation under different circumstances by analyzing their impact on manufacturers' profits, consumers' surplus, and the social welfare.

2 - Increased Remanufacturing through Take-Back Legislation and Competition

Gokce Esenduran, Fisher College of Business, Ohio State University, Columbus, United States of America, esenduran_1@fisher.osu.edu, Karthik Natarajan, Eda Kemahlioglu-Ziya

We consider an original equipment manufacturer (OEM) in a market regulated with take-back law that holds the OEM responsible for taking back and properly treating the used products. We model the competition between an OEM and an independent remanufacturer as a Stackelberg game where the OEM is the leader. We find that under competition, regulation may cause a decrease in remanufacturing levels. Also, the same level of regulation may induce higher remanufacturing in the presence of competition.

3 - Product Design or Cost Efficiency? – A Network Perspective on Extended Producer Responsibility

Luyi Gui, The Paul Merage School of Business, University of California, Irvine, Irvine, CA, 92697, United States of America, luyi.gui@gatech.edu, Atalay Atasu, Beril Toktay, Ozlem Ergun

Extended Producer Responsibility (EPR) is a policy tool that stipulates the financial responsibility of producers for post-use handling of their products. In this research, we provide an analytical assessment of the potential of the widely-adopted collective EPR implementations to provide design incentives to producers via cost allocation design. Our study demonstrates the impact of operational-level factors (e.g., synergy from resource sharing) on the design implication of EPR implementation.

4 - Procurement Auctions with Sustainability Audits

Karca Aral, PhD Candidate, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, karca.aral@insead.edu, Damian Beil, Luk Van Wassenhove

We study the supplier auditing and selection process in the presence of "unsustainability costs" within a procurement auction framework. We find that the value of sustainability audits need not increase as the pool of suppliers becomes less sustainable. Furthermore, even with ex ante symmetric suppliers, the current industry practice of blanket auditing the entire supply pool can be improved on by auditing only a subset of suppliers. Our insights also inform generic quality assessment policies.

■ SC46

Level 1 -101F

Energy and Raw Materials in Production

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Danko Turcic, Assistant Professor of Operations, Washington University in St. Louis, Olin Business School, St. Louis, MO, 63105, United States of America, turcic@wustl.edu

Co-Chair: Ankur Goel, Case Western Reserve University, Cleveland, OH, United States of America, axg312@case.edu

1 - Financial Hedging and Optimal Procurement Policies under Correlated Price and Demand

Ankur Goel, Case Western Reserve University, Cleveland, OH, United States of America, axg312@case.edu, Fehmi Tanrisever

We consider a firm that procures an input commodity to produce an output commodity to sell to the end retailer. The firm can sell the output commodity to the retailer either through a spot or a forward contract. We show that partial hedging dominates both perfect hedging and no-hedging when input price, output price, and demand are correlated. We also identify conditions under which myopic policy is optimal.

2 - Curtailing Intermittent Generation in Electrical Systems

Owen Wu, Assistant Professor, University of Michigan, 701 Tappan St., Ann Arbor, MI, 48109, United States of America, owenwu@bus.umich.edu, Roman Kapuscinski

Energy generation from intermittent renewable sources introduces additional variability into electrical systems, resulting in a higher cost of balancing against the increased variabilities. Ways to balance demand and supply for electricity include using flexible generation resources, storage operations, and curtailing intermittent generation. We focus on the operational and environmental impact of curtailment, and show that curtailment can be both economically and environmentally beneficial.

3 - Farm-yield Management when The Production Rate is Yield Dependent

Onur Boyabatli, Assistant Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road 04-01, Singaport, 178899, Singapore, oboyabatli@smu.edu.sg, Kwan Eng Wee

This paper analyzes the impact of farm-yield uncertainty when the unit production rate is yield dependent. We model a firm that procures an input through a contract in advance of the selling season; and through the open market on the day in a single period so as to maximize its expected profit. We investigate the impact of yield uncertainty on the optimal contract volume and the profitability of the firm, and underline the role of yield-dependent production rate on our results.

4 - A Strategic Approach to Hedging and Contracting

Danko Turcic, Assistant Professor of Operations, Washington University in St., Louis, Olin Business School, St. Louis, MO, 63105, United States of America, turcic@wustl.edu, Panos Kouvelis, Guang Xiao

We consider a model, where two identical firms compete in the output market and identify conditions under which neither firm hedges its production inputs, only firm hedges, and both firms hedge. In doing so, we provide a new rationale for hedging that is based on competitive behavior in product markets.

■ SC47

Level 1 -101G

Empirical Service Operations

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Robert Bray, Northwestern University, Kellogg School of Management, Evanston, IL, 60202, United States of America, robertlbray@gmail.com

1 - Effect of Resource Capacity on Utilization in Hospital Emergency Departments

Jillian Berry Jaeker, Harvard Business School, Soldiers Field, Boston, MA, 02163, United States of America, jjaeker@hbs.edu, Anita Tucker, Michael Lee

Our work focuses on how the availability of ultrasounds (US), a medical test, in a hospital emergency department (ED) affects their demand by physicians. We take advantage of a natural experiment at two Rhode Island EDs, which are staffed by the same physicians and located within 5 miles of each other. Over the course of our study period, US availability was increased at one hospital and not the other.

2 - Global Sourcing: Impact of Sourcing Strategies on Supply Chain Resilience

Nitish Jain, INSEAD, Singapore, 138676, Singapore, nitish.jain@insead.edu, Karan Girotra, Serguei Netessine

Global Sourcing firms expose themselves to varied kind of disruptions such as extreme weather events, labor unrest and natural disasters. Firm supply chains that are resilient to such disruptions have an advantage. Using a novel data set of over 3.5 million import transactions by U.S. retailers, wholesalers, and manufacturers, we study role of sourcing strategies in fostering supply chain resilience.

3 - Structural Estimation of Callers' Delay Sensitivity in Call Centers

Seyed Emadi, Assistant Professor, University of North Carolina at Chapel Hill, Kenan-Flagler Business School, 300 Kenan Dr, Chapel Hill, NC, 27599, United States of America, s-emadi@kellogg.northwestern.edu, Che-Lin Su, Baris Ata, Zeynep Aksin Karaesmen

We model callers' decision making process in call centers as an optimal stopping problem. The utility of a caller is modeled as a function of her waiting cost and reward for service that are estimated from the data of calls made to a call center. Our analysis reveals that modeling endogenous caller behavior can be important when major changes (such as a change in service discipline) are performed, and that using a model with an exogenously specified abandonment distribution may be misleading.

■ SC48

Level 1 -101H

Best Working Paper Award

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Anton Ovchinnikov, University of Virginia, Darden School of Business, 100 Darden Blvd, Charlottesville, VA, 22903, United States of America, aovchinnikov@darden.virginia.edu

1 - Best Working Paper Award

Anton Ovchinnikov, University of Virginia, Darden School of Business, 100 Darden Blvd, Charlottesville, VA, 22903, United States of America, aovchinnikov@darden.virginia.edu

Best Working Paper Award - award finalists (TBD in July/August 2013) will present their work.

2 - Trust, Trustworthiness and Information Sharing in Supply Chains Bridging China and the U.S.

Ozalp Ozer, Professor, The University of Texas at Dallas, Naveen Jindal School of Management, 800 West Campbell Road, Richardson, TX, 75080, United States of America, oozer@utdallas.edu, Yufei Ren, Yanchong Zheng

We experimentally study how cultural distinctions between China and the U.S. affect the efficiency of information sharing and operational decisions in global supply chains. We show how spontaneous trust and trustworthiness are lower in China than in the U.S., and Chinese show higher trust towards U.S. partners. The two populations exhibit drastically different behavioral dynamics under repeated interactions, rendering a Chinese supply chain to benefit more from a long-term relationship.

3 - Waiting Patiently: An Empirical Study of Queue Abandonment in an Emergency Department

Robert Batt, Assissant Professor, University of Wisconsin-Madison, 975 University Ave., Madison, WI, 53706, United States of America, batt@wharton.upenn.edu, Christian Terwiesch

We study abandonment from an emergency department queue and find that patients are influenced by what they observe in the waiting room: census, arrivals, and departures. Patients also make inferences about the severity of the patients around them and respond differently to people sicker and less sick moving through the system. These results show that in order to reduce patient abandonment, hospitals should carefully manage what information patients have regarding their wait.

4 - The Design of Experiential Services: Optimal Sequence and Duration of Service Activities

Aparupa Das Gupta, PhD Candidate, University of California-Los Angeles, Anderson School of Management, 110 Westwood Plaza, Los Angeles, CA, United States of America, aparupa@ucla.edu, Uday Karmarkar, Guillaume Roels

We address the optimal sequence and duration of activities in a service encounter where customer perceptions of experience are important, as in the hospitality, leisure, and entertainment industries. We employ evidence from behavioral studies about how people evaluate past experiences. We model these phenomena parsimoniously and design service processes to maximize ex-post customer satisfaction.

■ SC49

Level 1 -101I

Data-driven Decision-making in Non-stationary Environments

Cluster: Tutorials

Invited Session

Chair: Omar Besbes, Columbia University, Graduate School of Business, 3022 Broadway, New York, NY, 10027, United States of America, ob2105@columbia.edu

1 - Data-driven Decision-making in Non-stationary Environments

Omar Besbes, Columbia University, Graduate School of Business, 3022 Broadway, New York, NY, 10027, United States of America, ob2105@columbia.edu

A fundamental task that many dynamic decision-support systems face is to track underlying changes in the environment for better decisions. This tutorial will review classical work and recent approaches to decision-making in non-stationary and uncertain environments. We will present results on generic fundamental sequential decision problems but also review the specific challenges one faces in particular applications (e.g., dynamic pricing and inventory management).

■ SC50

Level 1 -101J

Sustainable Operations with an Emphasis on Electric Power Industry

Cluster: Climate Change and OR

Invited Session

Chair: Ozge Islegen, Assistant Professor, Northwestern University, Kellogg School of Management, 2001 Sheridan Rd., Evanston, IL, 60208, United States of America, o-islegen@kellogg.northwestern.edu

1 - Near-optimal Execution Policies for Demand Response Contracts

Vineet Goyal, Columbia University, New York, NY, United States of America, vgoyal@ieor.columbia.edu, Garud Iyengar, Rhea Qiu

Demand-response (DR) contracts are an important instrument in managing supply-demand imbalances in the current electricity market. We present a data driven algorithm that computes a near-optimal execution policy for Demand-Response contracts under capacity constraints. Our algorithm is based on the sample average approximation method and we also provide sample complexity bounds.

2 - Improving Electricity Market Operations to Accommodate Renewable Energy using Stochastic Programming

Canan Uckun, Argonne National Laboratory, 9700 S. Cass Avenue, Lemont, IL, 60439, United States of America, canan@anl.gov, Audun Botterud, John Birge

The expansion of renewable resources creates more uncertainty and variability in the operation of the power grid. The goal of this project is to develop novel stochastic formulations for commitment and dispatch of supply and demand resources considering the uncertainty in renewable energy. We investigate the potential benefits of stochastic programming compared to deterministic formulations. Our objective is to develop an efficiently solvable framework by using appropriate decomposition methods.

3 - Paying for the Smart Grid

Luciano De Castro, Northwestern University, Evanston, IL, United States of America, l-decastro@kellogg.northwestern.edu, Joisa Dutra

Smart grid (SG) technologies may bring substantial advantages to the society, but the required investments are also sizable. This paper establishes a framework for examining the issues related to the SG, and highlights some of the difficulties in funding SG investments. In particular, we show that generators will lose profits as a direct effect of demand response initiatives, and most of the benefits of SG cannot be easily converted into payments.

4 - The Effect of Climate Policy on Facility Location, Production and Shipping

Ozge Islegen, Assistant Professor, Northwestern University, Kellogg School of Management, 2001 Sheridan Rd., Evanston, IL, 60208, United States of America, o-islegen@kellogg.northwestern.edu, Erica Plambeck, Terry Taylor

One region imposes either a tax on GHG emissions or a cap-and-trade system in which the cost of a permit for emissions is uncertain and has mean equal to the tax. We show how variability in the permit cost affects the "leakage" of emissions, trade quantities, and social welfare in the region with climate policy under border adjustment.

■ SC51

Level 1 -102D

Paratransit Modeling

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Luca Quadrifoglio, Texas A&M University, CE/TTI Bldg Room 301-I, College Station, TX, 77843, United States of America, lquadrifoglio@civil.tamu.edu

1 - Innovative Operating Strategies for Para-transit Services

Luca Quadrifoglio, Texas A&M University, CE/TTI Bldg. Room 301-I, College Station, TX, 77843, United States of America, lquadrifoglio@civil.tamu.edu

A significant inefficiency of ADA Paratransit services using zoning strategies is related to the large amount of empty trip miles driven for serving cross-zonal customers. We explore innovative strategies for operating them by enabling providers to serve both trips of these customers in need of round trip rides and quantify the benefits in terms of a significant reduction of the empty trip miles and an improvement of the level of service. We investigate both static and dynamic scenarios.

2 - A Pickup and Delivery Problem for Ridesharing Considering Congestion

Xiaoqing Wang, Research Assistant, University of Southern California, 3715 McClintock Avenue, GER 240, Los Angeles, CA, 90089, United States of America, xiaoqinw@usc.edu, Maged Dessouky, Sven Koenig, Masabumi Furuhata, Fernando Ordonez

We consider a vehicle pickup and delivery problem with the objective of minimizing the total travel cost and customer ride time while considering the discounted toll rates on high occupancy vehicles and the availability of HOV lanes. A 0-1 integer programming model is formulated to solve the problem optimally. Heuristics are developed to efficiently solve the problem. The Adjust Pickup Time Algorithm and the Waiting Strategy are proposed to reduce the total cost and the customer ride time.

3 - Geographic Alignment of Service Regions for Paratransit in New Jersey

Eric Gonzales, Assistant Professor, Rutgers, The State University of New Jersey, Civil and Environmental Engineering, 96 Frelinghuysen Road, #606, Piscataway, NJ, 08854, United States of America, eric.gonzales@rutgers.edu, Mahour Rahimi, Mahyar Amirgholy

Access Link, NJ Transit's ADA paratransit service, faces a challenge in increasing the efficiency and effectiveness of its service, which is currently organized in six service regions. This research develops a methodology to analyze the agency's costs based on the demand and geographic alignment of these regions. A cost model is developed as a component of an optimization to minimize the cost, by choosing the number and coverage of service areas subject to quality of service constraints.

4 - An Exact Algorithm for the Time-dependent Mobility Allowance Shuttle Transit (MAST)

Peng Sun, PhD candidate, TU/e, Pav E 17, Eindhoven, 5600MB, Netherlands, P.Sun@tue.nl, Said Dabia, Tom van Woensel

In this paper, we study the Time dependent mobility allowance shuttle transit (MAST). Travel time function is depends on the departure time from a node and different travel time is generated and meets the FIFO property. First, we build a time dependent MAST model. Secondly , we use a time dependent shortest path algorithms to linearize the non-linear term in the proposed model. Finally, some simulation would be conducted.

■ SC52

Level 1 -102E

Innovative Humanitarian Logistic Formulations

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Jose Holguin-Veras, William H. Hart Professor, Rensselaer Polytechnic Institute, 110 8th St., Troy, NY, 12180, United States of America, jhv@rpi.edu

1 - The Stochastic Post-Disaster Debris Clearance Problem

Melih Celik, H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, melihcelik@gatech.edu, Ozlem Ergun, Pinar Keskinocak

Post-disaster debris clearance aims to connect demand and supply for disaster relief by clearing debris-blocked roads. In this study, we define the Stochastic Debris Clearance Problem (SDCP), where the debris amounts are partially known due to lack of data or information infrastructure. We propose a POMDP model and various heuristic approaches for SDCP. We also test the performance of these approaches and compare them to current practice using random instances and a potential disaster scenario.

2 - Modeling the Objective Functions in Humanitarian Logistics

Kai Huang, Assistant Professor, McMaster University, 1280 Main St. West, Hamilton, ON, L8S4M4, Canada, khuang@mcmaster.ca, Yufei Yuan, Yiping Jiang, Lindu Zhao

In this study, we characterize the life saving objectives of emergency resource allocation and distribution in disaster response operations, and propose an integrated model that captures these objectives. We identify two types of fundamental needs in life saving operations. The need to "save as many lives as possible" is modeled as a life saving utility function; while the need to "save lives as quickly as possible" is modeled as a delay cost function. We also model the fairness consideration.

3 - Markovian Decision Model for Capacity Adjustment in the Pods of Humanitarian Logistics Operations

Raul Rodolfo Je Heras Garrido, PhD, Iberoamericana University, Mexico City, Paseo de la Reforma 880 Lomas de Santa F, DF, 01219, Mexico, raul.heras@ibero.mx, Marco Antonio Serrato Garcìa, Jose Holguin-Veras

The Humanitarian Logistics have challenges in the delivery of critical supplies that are characterized by unexpected fluctuations in demand, the uncertainty in the capacity of the supply chain, and the need to respond immediately. The Markovian Decision Model developed in this study supports the decision and establishes policy decisions for each stage to minimize human suffering through the incorporation of the deprivation costs and the adjustment of the capacity in the points of distribution.

4 - Inventory-Allocation Models for Post-Disaster Humanitarian Logistics with Explicit Consideration of

Jose Holguin-Veras, William H. Hart Professor, Rensselaer Polytechnic Institute, 110 8th St., Troy, NY, 12180, United States of America, jhv@rpi.edu, Noel Perez

The paper develops novel mathematical models to maximize the benefits derived from the distribution of critical supplies to the populations in need after a disaster. The formulations are based on welfare economics and the use of social costs, which are the costs incurred by the segments of society involved in, and impacted by, the relief distribution strategy.

5 - On the Appropriate Objective Function for Post-Disaster Humanitarian Logistics Models

Felipe Aros-Vera, Rensselaer Polytechnic Institute, Troy, NY, United States of America, arosvm@rpi.edu, Jose Holguin-Veras, Miguel Jaller, Johanna Amaya

The paper discusses the incorporation of welfare economic principles in post-disaster humanitarian logistic models to ensure that delivery strategies lead to the greatest good for the greatest number of people. This quest's central goal is to take into account the human suffering associated with the lack of access to a good or service, which is referred as deprivation cost. The sum of logistic and deprivation costs represent the objective function of post-disaster humanitarian logistic models.

■ SC53

Level 1 -102F

Facility Logistics - II

Sponsor: Transportation Science & Logistics/Facility Logistics

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, Madison, WI, United States of America, ananth@engr.wisc.edu

1 - Queuing Models for Mobile Rack-based Order-pick Systems

Debjit Roy, Assistant Professor, Indian Institute of Management Ahmedabad, Wing 3C, Vastrapur, India, debjit@iimahd.ernet.in, Shobhit Nigam

Movable storage shelves (pods) that can be lifted and brought to the order-pick station by robotic vehicles can improve flexibility and productivity in picking activities. Closed queuing network models provide a rich framework for rapidly evaluating the throughput performance of such systems with alternate pick-area, vehicle sharing, and pod storage strategies.

2 - Effects of Relief Center Design and Routing Strategies on Aid Delivery Performance

Merve Ozen, Research Assistant, University of Wisconsin Madison, 3160 Engineering Centers Building, 1550 Engineering Drive, Madison, WI, 53706, United States of America, mozen@wisc.edu, Ananth Krishnamurthy

Disasters are catastrophic events and cause extensive damage and loss of lives. Distributing relief supplies efficiently in the immediate hours is critical. This paper investigates the effects of relief center design, routing strategies and staffing policies on the efficiency of aid delivery. Relief centers are modeled as a network of multi-class finite capacity queues with state dependent routing. Numerical investigations identify the combinations that result in fastest aid delivery to victims.

3 - Optimal Storage and Retrieval Policies for Unit-Load Warehouses

Fang Liu, Assistant Professor, Nanyang Technological University, Nanyang Business School, Singapore, Singapore, Liu_Fang@ntu.edu.sg, Yun Fong Lim

Optimizing storage and retrieval decisions is crucial for minimizing the operating cost of a unit-load warehouse. The problem is especially challenging when the warehouse faces time-varying product arrivals and random demand in a multi-period setting. We identify optimal storage and retrieval policies for a warehouse with general layout and storage classes. We will discuss some insights on these policies.

■ SC54

Level 1 -103A

Dynamic Traffic Assignment I - New Modeling Approaches

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Carolina Osorio, Massachusetts Institute of Technology, Cambridge, MA, United States of America, sorioc@mit.edu

1 - Diverge Models and Dynamic Traffic Equilibria

Stephen Boyles, Assistant Professor, The University of Texas at Austin, 301 E Dean Keeton St., Stop C1761, Austin, TX, 78712, United States of America, sboyles@mail.utexas.edu, Christopher L. Melson, Jennifer C. Duthie, Tarun Rambha

While dynamic traffic assignment models are known to exhibit multiple equilibria, we present a particularly pathological instance in which every feasible assignment is a user equilibrium, but in which the system optimum is unique, and show that the price of anarchy in this instance is unbounded. Practical implications of this phenomena are discussed, along with the use of piecewise-linear fundamental diagrams as one potential resolution.

2 - Continuous-time Dynamic System Optimum Model and Applications

Rui Ma, Research Assistant, Rensselaer Polytechnic Institute, 110 8th Street, JEC 5107, Troy, NY, 12180, United States of America, mar2@rpi.edu, Xuegang Ban

We propose an optimal control formulation for the continuous-time dynamic system optimal problem. We also show how the proposed model can used to model emergency evacuation applications.

3 - Multiclass Dynamic User Equilibrium with a Path Based Cell Transmission Model for General Traffic Networks

Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, Xianyuan Zhan

This paper presents a formulation for dynamic user equilibrium model with departure time choice and route choice for heterogeneous users and general traffic network. Cell transmission model (CTM) is embedded as the network loading procedure. The existence of equilibrium solution and OD level FIFO are proved. A new solution algorithm is proposed to solve the complementarity formulations. Numerical results show that the new algorithm outperforms the existing projection algorithm and capable of obtaining good equilibrium solution for general traffic networks.

4 - Dynamic User Equilibrium with Elastic Demand and Bounded Rationality: Formulation, Qualitative Analysis, and Computation

Hongcheng Liu, PhD Candidate, Pennsylvania State University, 240 Leonhard, University Park, PA, United States of America, hql5143@psu.edu, Ke Han, Tao Yao, Terry Friesz

Simultaneous route-and-departure choice dynamic user equilibrium with elastic demand, and with bounded rationality, are both formulated as variational inequality and differential variational inequality. Existence results are given. We further demonstrate that both models can be computed using fixed-point algorithms with satisfactory convergence results.

5 - A Continuum Model for Signalized Junctions and What It Means for the LWR Model on Networks

Yuqi Sun, Industrial and Manufacturing system Engineering, the Pennsylvania State University, 240 Leonhard, University Park, United States of America, yus139@psu.edu, Ke Han, Tao Yao, Terry Friesz

One way of approximating on-and-off signal control is by introducing a priority parameter and converting the problem setting to a continuum regime. We provide rigorous analysis on the convergence and error bound for such a continuum model in connection to the LWR model with spillback. We also show circumstances where such approximation is erroneous. This work provides theoretical support to a class of approximate models with reduced complexity and computational burden.

■ SC55

Level 1 -103B

Traffic Management in Evacuation

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Yue Liu, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee, Milwaukee, WI, United States of America, liu28@uwm.edu

1 - Behavior-consistent Information-based Network Traffic Control for Evacuation Operations

Yu-Ting Hsu, Purdue University, 3000 Kent Ave., Nextrans Center, West Lafayette, IN, 47906, United States of America, yhsu@purdue.edu, Srinivas Peeta

We propose an information-based control module to determine route guidance for evacuation traffic management. It seeks to incorporate realism by factoring likely evacuee response in the determination of route guidance, to seek consistency between evacuee behavior and the control objective. Numerical experiments are conducted; they highlight the importance of considering behavior-consistency and indicate the limits of implementing linguistic route guidance in real-world evacuation operations.

2 - Traffic Management in a Dynamic Evacuation Network: Trade-off between Signal and Cross-eliminations

Yue Liu, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee, Milwaukee, WI, United States of America, liu28@uwm.edu, Zhenke Luo

This paper develops a bi-level model to best trade-off between signal control and uninterrupted flow strategies for traffic management in a dynamic evacuation network. The upper level searches for the best distribution strategies with the objectives of minimizing the total evacuation clearance time. The lower level problem handles routing of evacuation traffic with the cell transmission model adopted to mathematically represent dynamic traffic flow evolution and queuing in an evacuation network.

3 - On-line Calibration-based Integrated Operational Framework for Mass Evacuation

Srinivas Peeta, Professor, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47906, United States of America, peeta@purdue.edu, Yu-Ting Hsu

We propose an operational framework for mass evacuation that integrates the three major aspects that shape an evacuation operation: demand, supply, and disaster. It is a stage-based framework where a rolling horizon approach is used to capture the dynamics of the evacuation network. An on-line calibration approach is developed in terms of evacuee behavior modeling. Numerical experiments are conducted to evaluate operational performance from both traffic and disaster management perspectives.

4 - A Lane-based Network Enhancement Model for Special Event and Emergency Traffic Management

Peng Li, Research Assistant, University of WIsconsin-Milwaukee, PO Box 784, Civil Engineering, Milwaukee, WI, 53201, United States of America, pengli@uwm.edu, Yue Liu

This paper presents a mathematical model for special event or emergency traffic management by simultaneously optimizing the distribution of signal and cross-elimination strategies, lane markings, turning restrictions, and signal timings in the network. The model features a bi-level structure and is solved with a GA-based heuristic.

■ SC56

Level 1 -103C

Modeling, Analysis and Mitigation of Uncertainty and Vulnerability in Power Grids

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Bo Zeng, University of South Florida, 4202 East Fowler Avenue, ENC2400, Tampa, FL, 33620, United States of America, bzeng@usf.edu

1 - Interdiction Analysis of Electric Grids Combining Cascading Outage and Medium Term Impacts

Yezhou Wang, University of Texas, Austin, TX, United States of America, nickncwang@utexas.edu, Ross Baldick

This paper presents an improved interdiction model to identify the maximal disruptive attack plans for terrorists. In the model, both short and medium term impacts of the possible attack are considered. The medium term impacts are examined by the interdicted DC OPF model. The short term impacts are assessed by a cascading outage analysis model. An improved integer programming heuristic is applied to solve the problem. The proposed model has been verified using the IEEE Test Systems.

2 - An Optimization Framework for Contingency-constrained Power Grid Operations

Neng Fan, Assistant Professor, University of Arizona, Tucson, AZ, 85721, United States of America, nfan@email.arizona.edu

In this talk, we embed the contingency criteria (such as N-1, N-k, N-1-1 contingencies) defined by NERC into the power system's planning and operations problems. The whole problem can be formulated as a large-scale MIP with exponential number of contingency constraints. Several methods based on decomposition are proposed. We test our models and algorithms on several IEEE systems.

3 - Detect Unobservable Attacks with Phasor Measurement Units

Feng Pan, Los Alamos National Laboratory, Los Alamos, NM, United States of America, fpan@lanl.gov, Russell Bent, Annarita Giani, Kameshwar Poolla

There've been increasing concerns about cyber-attack to power grids, partly due to the reliance on remote sensing. We first discuss unobservable attacks and introduce a bilevel program to model such attacks. Under sparse attacks, we show that enumerating upper-level extreme point is sufficient to get an optimal solution and is more efficient than KKT based approaches. We then introduce a model for placing phasor measurement units to detect unobservable attacks and present our empirical studies.

4 - Interdiction of Electric Power Grids with Spare Transformers

Javier Salmeron, Naval Postgraduate School, Operations Research Department, Monterey, 93943, United States of America, jsalmero@nps.edu, Kevin Wood

We study an attacker-defender (A-D) model for interdiction of electric transmission grids, where the D can utilize limited spare parts to repair high-voltage transformers damaged by A. We solve the A-D model by Global Benders decomposition, where A's master problem and D's subproblem are adjusted for spares. This can be solved via integer programming or an enumeration technique. We show how tradeoffs between spare transformers and load shedding can guide inventory strategies for spare equipment.

■ SC57

Level 1 -103D

Investment Decisions in Energy Systems

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Lizhi Wang, Iowa State University, 3016 Black Engineering, Ames, IA, 50011, United States of America, lzwang@iastate.edu

1 - Min-max Regret Robust Optimization for Power System Planning

Jianhui Wang, Affiliate Professor, Auburn University, 9700 S. Cass Avenue, Bldg. 221, Argonne, IL 60439, USA, Argonne, IL, 60439, United States of America, jianhui.wang@anl.gov, Bokan Chen, Lizhi Wang

Long-tern power system planning is constrained by many uncertain factors such as load profile, renewable energy penetration and output, availability of hydro power resources. In this talk, we will present a robust optimization algorithm for long-term power system planning to take into account these uncertainties. The objective of the algorithm is to propose a robust power system expansion plan that can be relatively less conservative while still robust to account for the worst-case scenarios.

2 - Modeling Interactions between Microgrids, Utilities, and Power Markets: A Regulator's Perspective

Venkat Prava, PhD Student, The Johns Hopkins University, Baltimore, MD, United States of America, vprava1@jhu.edu, Ben Hobbs, Chiara LoPrete

We study development of microgrids (MG) in two settings: a regulated vertically integrated utility and a distribution utility/degulated bulk power market. Cost and technology scenarios are considered for each. For each of setting and scenario we use cooperative game theory to determine whether entry would take place and be consistent with market efficiency. Market failures could block efficient entry, or incent inefficient entry. Regulatory mechanisms to ensure efficient outcomes are analyzed.

3 - A Two-stage Stochastic Transmission Planning Model Considering Dependent Load and Wind

Heejung Park, The University of Texas at Austin, 1 University Station C0803, Austin, TX, 78712, United States of America, tohjpark@gmail.com, Ross Baldick, David Morton

We present a two-stage stochastic model for transmission system expansion planning with two dependent random variables, load and wind. Sample realizations of load and wind are generated using Gaussian copula. Candidate solutions for 200 and 300 random samples are represented. A 95% confidence interval on the optimality gap is assessed for the solution quality of a candidate stochastic solution. Optimal power flow is solved based on the linearized direct current (DC) power flow.

4 - Potential Competition for Biomass between Biopower and Biofuel under RPS and RFS2

Mohammad Rahdar, Iowa State University, Black Engineering, Ames, IA, 50011, United States of America, rahdar@iastate.edu, Lizhi Wang, Guiping Hu

Driven by RPS and RFS2, biopower generation and biofuel production will increasingly compete for biomass in the future. We study this competition as well as other interactions between two policies. Our model describes the U.S. renewable energy portfolio by explicitly accounting for all major renewable energy resources and policy requirements in all states through 2035. Our modeling results were used to address five important questions regarding the impact on the U.S. renewable energy portfolio.

■ SC58

Level 1 -103E

Wildfire Management 2: Efficiency of Pre-suppression and Suppression Activities

Sponsor: Energy, Natural Res & the Environment/ Forestry/Mining

Sponsored Session

Chair: Matthew Thompson, Research Forester, US Forest Service, PO Box 7669, Missoula, MT, 59807, United States of America, mpthompson02@fs.fed.us

1 - Past, Present and Future of the Fire Planning Analysis System

Darek Nalle, djnalle@fs.fed.us, Matthew Thompson

The Fire Planning Analysis system was created by the Federal government to inform the allocation and distribution of pre-suppression resources. The system is currently undergoing redesign. New research enhancements will be overviewed, with particular focus on optimization capabilities.

2 - Wildfire Suppression Constraints within A Stochastic Integer Programming Fire Spread Model

Erin Belval, Colorado State University, Campus Delivery 1472, Fort Collins, CO, 80523, United States of America, mccowene@gmail.com, Mike Bevers, Yu Wei

Assigning wildfire suppression resources safely and efficiently is a complex task. We developed constraints that realistically mimic wildfire suppression activities, which can be used within a stochastic programming formulation that models fire spread and intensity. Solutions to the model suggest optimal suppression activities for a known ignition given a probability distribution of random weather scenarios. The formulation is designed to handle multi-objective fire policies where portions of a fire may be allowed to spread and other portions are contained.

3 - Large Airtankers and Suppression: Comparing Models and Reality

Matthew Thompson, Research Forester, US Forest Service, PO Box 7669, Missoula, MT, 59807, United States of America, mpthompson02@fs.fed.us

Large airtankers are prized for their ability to quickly travel to fire starts and to facilitate containment during initial attack operations. Subsequently optimization models for supporting large airtanker fleet composition and location-allocation decisions are premised on the primary use of large airtankers being for initial attack. But is that how large airtankers are actually used? This presentation will review recently uncovered trends in large airtanker use in the U.S., explore implications, and discuss future opportunities for improving efficiencies.

4 - Operational Flexibility in Forest Fire Suppression and Prevention

Abílio Pacheco, INESC Porto, Rua Dr. Roberto Frias, 378, Porto 4200-465, Portugal, abilio.pacheco@fe.up.pt, João Claro

We model intra-annual fire management as a problem of multistage capacity investment in a portfolio of management resources, enabling fuel treatment and fire suppression. We consider wildfires as the demand, with uncertainty in the severity of the fire season and in the occurrence, time, place, and severity of specific fires. We focus our analysis on postponement flexibility (fuel treatment, suppression), spatial flexibility (helicopters, ground crews) and the risk of supply and demand mismatch.

■ SC59

Level 1 -103F

Environmental Energy Models

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Cheng-Marshal Wang, EC, 80 Westpointe Crescent, Ottawa, ON, K2G 5Y9, Canada, Cheng-Marshal.Wang@ec.gc.ca

1 - Potential Impacts of Bidding Mechanism on the Integration of Renewables with Existing Power Grid

Zhaomiao Guo, UC Davis, Dept. of CEE, Davis, United States of America, watersguo@gmail.com, Yueyue Fan

In this talk, we present a mathematical model that captures the behaviors of and the interdependence between players along the different echelons of an electricity supply chain when integrated with renewable sources. Based on this model, we further examine how different bidding mechanism might affect the efficiency of the system, and how to identify an efficient mechanism that has the best potential for encouraging the integration of renewables to the existing power infrastructure.

2 - Modeling the Forest Rotation Problem under the Influence of Kyoto Protocol

Yavuz Gunalay, Bahcesehir University, Faculty of Economics and Admin Science, Istanbul, 34353, Turkey, yavuz.gunalay@bahcesehir.edu.tr, Erhun Kula

Importance of the forestry sector has risen in recent years due to efforts to reduce the threat of climate change backed by the Kyoto Protocol. Forests because of their large biomass content make an important contribution to the global carbon cycle that has been recognised by the Kyoto Agreement which gives carbon credits to countries when they create new forest areas. Such credits affect the planning horizon especially for plantation forests.

3 - Analysis of the Effect of Technology Distribution on the Water Requirements for Energy Generation

Erica Stults, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01609, United States of America, estults@wpi.edu, Andrew Trapp, John Bergendahl, Isa Bar-On

Thermoelectric power generation uses approximately 50 percent of the water withdrawn in the US. We explore the replacement of existing power generation plants in Texas by alternative energy technologies, with a focus on solar and wind, and its effect on water withdrawal and/or consumption. We show how the replacement of traditional thermoelectric generation technologies with renewable solar and wind technologies can reduce future water demands for power generation.

4 - The Model Design and Development on Oilsands CCS in Global Integrated Assessment Model

Cheng-Marshal Wang, EC, 80 Westpointe Crescent, Ottawa, ON, K2G 5Y9, Canada, Cheng-Marshal.Wang@ec.gc.ca

We will first review the new developments of Environment Canada Integrated Assessment Model (EC-IAM), which is a global inter-temporal hybrid model combining economical module and technical module. Then we will present the current working in designing the new module of Oilsands with Carbon Capture and Storage (CCS) technology. We have recalibrated ex-ante on the newest data and projection available and Modeling of CCS in Oil Sands sector has been conducted by some US agents but not in EC.

■ SC60

Mezzanine - 100A

Community Detection and Influence Analysis in Social Networks

Sponsor: Data Mining

Sponsored Session

Chair: Nick Street, Professor, University of Iowa, S232 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, nick-street@uiowa.edu

1 - Co-evolving Networks: From Telecom to Social to Disease Networks

Nitesh Chawla, University of Notre Dame, 384 Nieuwland Science Hall, Notre Dame, IN, 46556, United States of America, nchawla@nd.edu

The process of link formation/dissolution is a fundamental aspect of evolution of networks over time. However, to effectively predict this process over time is a challenging problem that may require an intimate understanding of the topologies and flows of each network, network endogeneity and co-evolution, as well as node attributes. In this talk, I will present the theory, analytics and models for link formation over time.

2 - A Novel Algorithm for Community Detection and Influence Ranking in Networks

Wenjun Wang, University of Iowa, S283 Pappajohn Business Bldg, Iowa City, IA, 52242, United States of America, wenjun-wang@uiowa.edu, Nick Street

We exploit the implicit knowledge of influence-based connectivity and similarity encoded in network graph topology, and propose a novel algorithm that provides significant insight into community detection and influence analysis. Our approach creatively differentiates the influence ranking in a more meaningful and detailed manner. Experiments on both real-world and simulated networks show the superior performance of our algorithm for community detection.

3 - Influence: Do Birds of a Feather Retweet Together?

Shawndra Hill, University of Pennsylvania, Philadelphia, PA, United States of America, shawndra@wharton.upenn.edu, Adrian Benton

We explore influence by gender across a variety of contexts – in particular, we focus on influence when talking about brands from TV commercials on Twitter immediately after they have been aired. We find that men are more likely to retweet men and women are more likely to retweet women even after controlling for diversity and size of the original tweeters network. We also find that the type of language explains the pairwise difference in retweeting even further.

4 - Community Detection in Networks: Global vs. Local Optimization

Santo Fortunato, Associate Professor, Aalto University, Rakentajanaukio 2 C, Espoo, 02150, Finland, santo.fortunato@aalto.fi

Finding communities in networks is crucial to understand their structure and function, to identify the role of the nodes and uncover their hidden relationships. I will introduce global optimization methods, focusing on modularity optimization. I will highlight conceptual and technical problems of such techniques, like the presence of hidden scales, mostly due to underlying global null models. Local optimization methods do not suffer from these limitations and are potentially more suitable.

■ SC61

Mezzanine - 100B

Joint Session DM/HAS: Data Mining in Medical Decision Making and Bioinformatics Applications

Sponsor: Data Mining & Healthcare

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, Atlanta, GA, United States of America, kamran.paynabar@isye.gatech.edu

1 - Interactive Q-learning

Eric Laber, Assistant Professor, North Carolina State University, 102 Glenbrae Ct, Cary, NC, 27518, United States of America, eblaber@ncsu.edu, Krisin Linn, Len Stefanski

There is interest in estimating optimal treatment policies from sequentially randomized clinical trials. Current approximate dynamic programming approaches rely on non-smooth, non-monotone transformations of the data, complicating model building and formal model diagnostics. We propose an approximate dynamic programming algorithm that uses smooth, monotone transformations of the data; the proposed algorithm yields asymptotically normal estimators and facilitates formal model diagnostics.

2 - Network Granger Causality with Inherent Grouping Structure

George Michailidis, University of Michigan, 1085 South University Ave., 439 West Hall, Ann Arbor, MI, 48109, United States of America, gmichail@umich.edu

In this work, we aim to learn the structure of the network over time employing the framework of Granger causal models under the assumptions of sparsity of its edges and inherent grouping structure among its nodes. We introduce a thresholded variant of the Group Lasso estimator for discovering Granger causal interactions among the nodes of the network. Asymptotic results on the consistency of the new estimation procedure are developed. The methodology is illustrated on real and synthetic data.

3 - Multimodal and Multiresolution Analysis and Visualization of Experimental Data

Daniela Ushizima, PhD, Lawrence Berkeley Lab, 1 Cyclotron, Berkeley, CA, 94720, United States of America, dushizima@lbl.gov

Advancements in image acquisition allows collection of unprecedented amounts of medical data, including modalities at different space-time scales. The challenge is to develop/evaluate protocols to quantify these datasets, e.g., characterization of individuals and colocalization of features under distinct imaging modalities. This talk will describe work in quantitative image analysis, including description of microstructure of materials and biomedical images (ophthalmologic and neurological data).

4 - Flow Modeling and Prediction of Heterogeneous Patients using Semi-Markov Mixture Clustering

Chitta Ranjan, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, nk.chitta.ranjan@gatech.edu, Kamran Paynabar, Jonathan Helm

Planning methods in hospitals rely on accurate estimation of patient flow for census predictions. We propose a hybrid clustering-classification prediction model for better estimation of patient flow. Semi-Markov model-based clustering is developed to cluster a heterogeneous mix of patients into homogeneous groups of patients with similar flow patterns. The clustering model is then linked with a classifier to predict the patient flow based on patient attributes.

■ SC62

Mezzanine - 100C

Nanomanufacturing and Nanoinformatics I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Ave., GER 240, Los Angeles, CA, United States of America, qiang.huang@usc.edu

1 - Graph Theory-based Coarse-graining Potential Function Fitting for Atomistic Simulations

Satish Bukkapatnam, Professor, Oklahoma State University, 322 Engineering North, Oklahoma State University, Stillwater, OK, United States of America, satish.t.bukkapatnam@okstate.edu, Changqing Cheng

Atomistic molecular dynamics and Monte Carlo simulations have been widely used to study nanomanufacturing processes, but the computational overhead has limited the simulations only to the initial nano-synthesis stage. A graph theory-based coarse-graining potential fitting approach was investigated to coarse grain the atomistic simulation, and realize large-scale simulation of the nanomanufacturing processes.

2 - Time Series Analysis of Acoustic Signals during Sonication of Carbon Nanotube Suspension

Kan Wang, Post-Doctoral Fellow, Georgia Institute of Technology, 813 Ferst Dr. NW, Rm 375, Atlanta, GA, 30332, United States of America, kan.wang@gatech.edu, Chuck Zhang, Yung-Hang Chang, Jianjun Shi, Ben Wang

Acoustic signals are collected during sonication of carbon nanotube (CNT) suspension. Those signals are fitted into ARMA models and their vibration modes are analyzed. The relationship between the strength of one of the vibration modes and the amount of CNT clusters in the suspension is revealed by controlled experiments. An innovative online monitoring method for sonication of CNT suspension is developed based on this time series analysis.

3 - Mapping Nanostructures Resulting from Severe Shear Deformation

Ravi Shankar Meenakshisundaram, Associate Professor, University of Pittsburgh, Department of Industrial Engineering, Pittsburgh, PA, 15261, United States of America, ravishm@pitt.edu

Nanostructured metals resulting from severe shear deformation offer novel combinations of functional and mechanical properties to offer innovative device design opportunities. Realizing these requires an understanding of the interconnections between process parameters and statistical distributions of the nanograin size, interface structure and defect densities. Here, I will present integration of experimental methods, electron microscopy and modeling efforts aimed at achieving this elucidation.

■ SC63

Mezzanine - 100D

Advanced Multivariate Statistical Analysis for Quality and Performance Improvement

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jian Liu, The University of Arizona, 915 North Tyndall Avenue, Tucson, AR, 85721, United States of America, jianliu@email.arizona.edu

1 - Estimation and Monitoring of Spatial Defect Patterns

Matthew Plumlee, PhD Student, Georgia Institute of Technology, North Ave., Atlanta, GA, 30332, United States of America, mplumlee@gatech.edu, Jianjun Shi

The talk discusses a common scenario where each product is scanned for potential defects and a set of points representing the location of the associated defects is recorded. While individual defects occur sporadically on a single product, meaningful diagnostic analysis requires estimation of a spatial pattern of defects during production. Newly developed procedures using functional (nonparametric) statistics are illustrated using production data from a steel rolling mill.

2 - An Adaptive Step-down Procedure for Fault Variable Identification

Myong K Jeong, Associate Professor, Rutgers University, Piscataway, NJ, 08854, United States of America, mjeong@rci.rutgers.edu, Jinho Kim, Elsayed A. Elsayed, Abdelmajid Hamouda, Khalifa Al-Khalifa, Wook-Yeon Hwang

An adaptive step-down procedure using conditional T^2 statistics is proposed for fault variable identification. The procedure selects a variable having no significant evidence of a change at each step based on the variables that are selected in previous steps. The selected variables are useful to construct powerful conditional T^2 test statistics for identifying the shifted components of the mean vector when a shift occurs only in a few variables.

3 - Quality Improvement in Battery Manufacturing through Selective Assembly

Feng Ju, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, fju2@wisc.edu, Jingshan Li

This article studies selective assembly for a two-component assembly system with finite buffers, where each component can exhibit different quality behaviors. Such a model is applicable to battery assembly process to improve quality. Analytical methods based on a two-level decomposition procedure are developed to evaluate the system performance, and the estimation accuracy is justified numerically. In addition, structure properties are investigated to provide insights on performance improvement.

4 - Dirichlet Process Based Symbolic Analysis for Change Point Detection in Autocorrelated Data

Zimo Wang, Research Assistant, Oklahoma State University, 322 Engineering North, Stillwater, OK, United States of America, zimo@ostatemail.okstate.edu, Satish Bukkapatnam, Zhenyu (James) Kong

The Dirichlet process based symbolic dynamic is proposed to detect process changes in autocorrelated data. The transition matrix is constructed for symbol sequence based on Dirichlet process clustering. The change of eigenvector distribution and likelihood value are used to capture the process change. Case study, which uses the ARMA model structure, shows that the proposed methodology is more effective in detecting the process changes than the widely used control charting methods.

■ SC64

Mezzanine - 100E

Patient-Centric Healthcare Delivery II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abe Zeid, Northeastern University, Department of Mechanical & Industrial Engineering, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA 02115, zeid@coe.neu.edu

Co-Chair: Sagar Kamarthi, Northeastern University, United States of America, sagar@coe.neu.edu

1 - Individual Dissatisfaction-reversion Based Group Decision Making and its Application on Health Care

Jian Hu, Assistant Professor, University of Michigan - Dearborn, 4901 Evergreen Rd., Dept. of IMSE, University of Michigan-De, Dearborn, MI, 48128, United States of America, jianhu@umich.edu, Yung-wen Liu

We study improving individual-satisfaction in group decision-making problems. A decision is conducted to fairly represent a social preference. This is illustrated by a medical decision problem for pregnant women to choose either chorionic villus sampling or amniocentesis.

2 - Integrating Routine Data to Reduce Acute Attendances and Admissions

Derek Ceglarek, University of Warwick, Institute of Digital Healthcare, International Digital Laboratory, Warwick, United Kingdom, D.J.Ceglarek@warwick.ac.uk, Sudi Lahiri

]: Unnecessary variations in care processes at an emergency department can result in patients diverting from care pathways triggering avoidable acute attendances and admissions. This is especially common among patients with co-morbidities. We used routine hospital data to model patient healthcare journeys to reduce avoidable acute contacts and healthcare system inefficiencies.

3 - Stochastic Optimization for Surgical Team Selection in Robotic Surgery

Armagan Bayram, Doctoral Candidate, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, abayram@som.umass.edu, Senay Solak

We evaluate operating room efficiency in robotic surgery through portfolio based stochastic optimization. Although the experience of every team member makes a difference, the performance in the operating room depends on the combination of experiences. Using actual data and integrating it into a stochastic optimization framework, we identify some results on optimal team configuration for robotic surgery.

4 - Healthcare Process Discovery and Visualization

Rahul Basole, Associate Professor, Georgia Institute of Technology, 85 Fifth St., NW, Atlanta, GA, 30332, United States of America, basole@gatech.edu, Polo Chau

Healthcare processes are complex and dynamic activities that span organizational, spatial, and temporal boundaries. Systemic insights are consequently difficult to achieve. Our research develops a data-driven methodology, fusing systems modeling, data mining, and information visualization, to identify, describe, and visualize complex healthcare enterprise processes. We illustrate our methodology with a real-world example.

5 - Simulation Modeling and Analysis of a Multi-resource Medical Clinic

Bo Sun, University of Louisville, Department of Industrial Engineering, University of Louisville, Louisville, KY, 40292, United States of America, B0SUN004@louisville.edu, Brooke Sweeney, Gerald Evans, Lihui Bai

We investigate a medical clinic that offers a range of face-to-face services for overweight children by providers such as medical doctors, nutritionist and psychologist. The multi-resource nature of the clinic experiences asymmetric no-show rates amongst providers. Through the development and analysis of a long period simulation model, we investigate various appointment scheduling schemes in order to improve both the clinic's efficiency and patient satisfaction.

■ SC65

Mezzanine - 100F

Methods and Models for Big Network Data

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Bin Zhang, Assistant Professor, Temple University, 209J Speakman, 1810 N. 13th St., Philadelphia, PA, 19122, United States of America, bzhang@temple.edu

1 - Reasoning about Uncertainty in High-Dimensional Statistics, and Social Network Analysis

Adel Javanmard, PhD Candidate, Stanford University, Room 239, 350 Serra Mall, Stanford, CA, 94305, United States of America, adelj@stanford.edu, Andrea Montanari

A common task in modern data analysis is to predict a response variable based on a large number of potentially relevant attributes. Existing methods allow to predict an expected value for the response, but do not account for its intrinsic variability. Variability is instead crucial whenever we intend to take actions based on the predictions. I will present a new, theoretically well-motivated approach to this problem, and illustrate it on applications in the domain of social network analysis.

2 - Consistency of Co-clustering Exchangeable Graph Data

David Choi, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, davidch@andrew.cmu.edu, Patrick Wolfe

We analyze the problem of partitioning a 0-1 array or bipartite graph into subgroups (also known as co-clustering), under a relatively mild assumption that the data is generated by a general nonparametric process. Our result suggests that the stochastic co-blockmodel and other community detection algorithms may be robust to model misspecification. (arXiv:1212.4093).

3 - Non-Parametric Scan Statistics for Event Detection in Heterogeneous Social Media Graphs

Feng Chen, Postdoctoral Research Fellow, Carnegie Mellon University, 5308 Beelermont Place, Pittsburgh, PA, 15217, United States of America, fchen1@cmu.edu, Daniel B. Neill

Event detection in social media is an important but challenging problem. Existing approaches focus on burst detection, topic modeling, or clustering techniques, which cannot model the heterogeneous network structure in social media. This paper converts the network in to a "sensor" network, proposes non-parametric scan statistics to model the heterogeneity, and develops efficient non-parametric scanning algorithms for event detection. Validations were conducted on real-life twitter data sets.

4 - A Local Algorithm for Detecting Evolving Communities in Large Weighted Networks

Bin Zhang, Assistant Professor, Temple University, 209J Speakman, 1810 N. 13th St., Philadelphia, PA, 19122, United States of America, bzhang@temple.edu, Zoran Obradovic, Mladen Nikolic

We present an effective method for community detection in large directed weighted dynamic networks. Our method scales well to networks with millions of nodes observed over time. It is applied to synthetic and real networks and experiments show that the proposed method is the proposed method is as efficient and accurate as the leading algorithms for static unweighted graphs, more importantly it is also effective to identify dense communities in large weighted and in large evolving networks.

■ SC66

Mezzanine - 100G

Topics in Information Systems Research

Sponsor: Information Systems

Sponsored Session

Chair: Monica Johar, Assistant Professor, University of North Carolina at Charlotte, United States of America, msjohar@uncc.edu

1 - IT-Marketing Coordination Decisions under Dynamic Inter-firm Competition

Dengpan Liu, Assistant Professor, Iowa State University, College of Business, Ames, IA, 50011, United States of America, dliu@iastate.edu, Subodha Kumar, Vijay Mookerjee

Extant research has shown that firms can resolve the over-spending problem through effective coordination between IT and Marketing departments. In this study, we examine whether the firms in a differential game theoretical setting can still benefit from the intra-firm coordination.

2 - On-line Algorithms for Maximizing Throughput with Equal Length Jobs in the Presence of Look-Ahead in the Future

Ishwar Murthy, Professor, Indian Institute of Management Banglore, India, ikm130030@utdallas.edu, Sumit Sarkar

In this paper, we consider the problem for maximizing throughput of jobs whose processing times are all equal to p. We have information about release times and due dates of jobs Kp time periods into the future, where K = 1. However, we have no information about jobs that might arrive beyond Kp time periods into the future. We present on-line algorithms for this problem and establish their competitive ratio.

3 - An Agent-based Model for Managing Short-Term Demand for Software Development Tasks

Su Dong, Arizona State University, Arizona State University, Tempe, AZ, United States of America, Su.Dong.1@asu.edu, Ram Kumar, Monica Johar

We model a scenario where short-term demand for software tasks is managed by using a pool of potential workers who bid for these tasks. This pool of workers is dynamic and workers may not always bid for tasks. We illustrate how worker utility and task allocation affect software development performance.

4 - Economic Impact of Recommender Systems on Firms and Customers

Abhijeet Ghoshal, University of Minnesota, 19th Ave. S., Minneapolis, United States of America, abhijeet@umn.edu, Sumit Sarkar, Vijay Mookerjee

Recommendation systems provide firms with an increased ability to target customers with products and services that match their needs. However, is a better recommender system always beneficial for a firm? To study this question, we consider monopolistic and duopolistic markets where customers are heterogeneous in their search costs. We derive conditions and provide managerial insights for situations when improving recommendation systems may increase or decrease profits of firms in these markets.

■ SC67

Mezzanine - 100H

Selecting Objectives

Sponsor: Decision Analysis

Sponsored Session

Chair: Jay Simon, Naval Postgraduate School, 699 Dyer Rd., Monterey, CA, United States of America, jrsimon@nps.edu

Co-Chair: Johannes Siebert, University of Bayreuth, Bayreuth, Germany, Johannes.Siebert@uni-bayreuth.de

1 - Risk Attitudes for Means Objective

Candice Huynh, University of California, Irvine, Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, candich@uci.edu, Jay Simon

We study how communication about risk is often presented to people. We examine whether people are able to process and apply the information about a nonlinear relationship between a means and fundamental objective correctly. We find that people are equally likely to exhibit risk aversion in the domains of the means objective and fundamental objective, and thereby disregard the nonlinear relationship between the means and fundamental objective.

2 - Selecting a Quality Set of Objectives

Ralph Keeney, Research Professor Emeritus, Duke University, 101 Lombard Street, #704W, San Francisco, CA, 94111, United States of America, keeneyr@aol.com

Selecting a quality set of objectives for a decision is itself a decision with quality defined by the planned uses of those objectives. Several potential uses are presented. Concepts and procedures to create and select a quality set of objectives for different uses are presented and illustrated with several cases.

3 - Objectives Enhances the Number and Quality of Alternatives

Johannes Siebert, University of Bayreuth, Bayreuth, Germany, Johannes.Siebert@uni-bayreuth.de

According to Keeney (1992), Value-focused Thinking postulates that objectives should be used to create alternatives. We conducted a series of empirical studies to analyze the effect of the stimulation by objectives in the process of creating alternatives. The results confirm the hypotheses that stimulation with objectives leads to more alternatives, better alternatives, and better sets of alternatives.

4 - Energy Objectives for the U.S. Department of Defense

Jay Simon, Naval Postgraduate School, 699 Dyer Rd., Monterey, CA, United States of America, jrsimon@nps.edu, Eva Regnier

Energy is a crucial issue to many organizations within the United States Department of Defense (DoD). However, these organizations provide differing objectives. We examine strategy and policy documents from DoD and related organizations to determine an appropriate set of objectives to evaluate potential decision alternatives related to energy.

■ SC68

Mezzanine - 100I

Decision Analysis Applications in the Healthcare Sector

Sponsor: Decision Analysis

Sponsored Session

Chair: Jeff Stonebraker, North Carolina State University, Poole College of Management, Raleigh, NC, United States of America, jsstoneb@ncsu.edu

1 - The Next Frontier for Portfolio Management - Med Tech Companies

Jack Kloeber, Principal, Kromite, Chruchville, PA, United States of America, jkloeber@kromite.com

Some industries have had decades of experience with decision analysis and rigorous portfolio analysis- Healthcare and Oil and Gas are two of them. However, within Healthcare, Pharmaceuticals and Hospital systems have seen the greatest use of DA and portfolio management. Pharmaceutical supply chain has seen huge strides in quality and efficiency. Medical decision making has also seen a dramatic increase in solid DA work. Medical devices and diagnostics, however, have not seen the same use.

2 - Bayesian Decision Model for Analyzing Mode of Delivery Considering Mother and Child Outcomes

Julie Ivy, Associate Professor, North Carolina State University, Edward P. Fitts Department of Industrial, 400 Daniels Hall, Raleigh, NC, 27695-7906, United States of America, jsivy@ncsu.edu, Karen Hicklin, Vidyadhar Kulkarni, Meera Viswanathan, Evan Myers

In the US over 4 million births occur annually and almost one in three deliveries is by cesarean section (c-section). As of 2010 c-section was the most common major surgical procedure performed. This abdominal surgery is associated with increased neonatal and maternal risk. The decision to perform a c-section is complex and varies by patient. A Bayesian decision model is developed to identify optimal policies for a trial of labor as a function of labor progression measured by cervical dilation.

3 - Stochastic Game Models for the Liver Transplant Waitlist

Gordon Hazen, Professor, Northwestern University, IEMS Department, McCormick School of Engineering, Evanston, IL, 60208-3119, United States of America, gbh305@northwestern.edu, Anton Skaro, Zhe Li, James Schummer

A 2007 Federal mandate requires an increase in marginal quality liver transplant offers. To investigate the response of the liver waitlist to increases/decreases in marginal quality organ offers, we construct stochastic game models in which players are waitlist members. We demonstrate the existence of Markov perfect equilibria, as well as oblivious equilibria for this system, devise methods for computing these, and report predictions of waitlist behavior under more/fewer marginal organ offers.

4 - Global Capacity Expansion under Uncertainty with Supply-Demand Imbalances

Jeff Stonebraker, North Carolina State University, Poole College of Management, Raleigh, NC, United States of America, jsstoneb@ncsu.edu

We present an application of decision analysis to global production capacity planning for a proposed new biotechnology drug to treat hemophilia A. This decision analysis addressed global production capacity expansion under uncertainty when supply is limited due to manufacturing complexities, and regional supply-demand imbalances exist during the product-generation transition.

■ SC69

Mezzanine - 100J

Stochastic Decision Analysis

Contributed Session

Chair: Mahdieh Allahviranloo, University of California, Irvine, 2411 Verano Place, Irvine, CA, 92617-3195, United States of America, mallahvi@uci.edu

1 - Performance Evaluation Inflation and Compression

Russell Golman, Carnegie Mellon University, Department of Social & Decision Sciences, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, rgolman@andrew.cmu.edu, Sudeep Bhatia

We provide a behavioral account of subjective performance evaluation inflation (leniency bias) and compression (centrality bias). If a manager observes noisy signals of employee performance and strives to produce accurate ratings but feels worse about unfavorable rather than favorable errors, ratings will be biased upwards. Bias is increasing in the variance of the performance signal and in the aversion to low ratings. Performance appraisals based on unambiguous criteria may have less bias.

2 - Multi-state Bayesian Process Control over a Finite Horizon

Jue Wang, PhD Candidate, Department of Mechanical & Industrial Engineering, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, juewang@mie.utoronto.ca, Chi-Guhn Lee

We study a POMDP model for general multi-state proces control in finite horizon. We show that there exist two cut-off horizons, which divide the entire horizon into at most three stages: no alarm stage, intermediate stage and polar control limit stage. Three multi-state problems - competing assignable causes, increasing failure rates, and semi-Markov deterioration - are solved as special cases. Many of the findings in the three cases would not have been seen in the traditional two-state model.

3 - Minimal Representation and Moment Fitting for MAP(2)

Sunkyo Kim, Professor, Ajou University, San 5, Suwon, Korea, Republic of, sunkyo@ajou.ac.kr

We propose a minimal representation and moment fitting method for a MAP(2). With the new representation, MAP(2) moment fitting procedures are simplified as a generalization of the MMPP(2). Moreover, MAP(2) can be used for modeling cross correlation in queueing networks by the fitting based on the second and third moments of counting process. As for the moment fitting procedure, moments are converted into our minimal representation and then converted into Markovian representation.

4 - A Multivariate Probit Model of Individual's Activity Participation Behavior

Mahdieh Allahviranloo, University of California, Irvine, 2411 Verano Place, Irvine, CA, 92617-3195, United States of America, mallahvi@uci.edu

In this study we modeled activity participation behavior of residents of Southern California using Multivariate Probit model. A Gibbs sampling technique is used to capture the full covariance matrix among work, school, personal, recreational, pickup and drop off activities. A comparison between an independent model, where the off-diagonal elements of covariance are zero, and the multivariate probit model shows the latter predicts the actual behavior of individuals with higher accuracy.

■ SC70

Mezzanine -101A

Uncertainty and Aviation Planning

Sponsor: Aviation Applications

Sponsored Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Department of IOE, Ann Arbor, MI, 48109, United States of America, amycohn@umich.edu

1 - Weather and Operational Performance

George Tam, Undergraduate Student, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, gtam@umich.edu, Amy Cohn

Weather plays a direct role in airline performance, but also plays many complex and subtle indirect roles as well. We present our development of a large database comprised of exhaustive flight and weather data for a ten year period and discuss our preliminary analyses. Our long-term goal is to enable better forecasting of weather impacts on network performance and predictions to enable improved interventions and recovery actions.

2 - Airline Flight Schedule Optimization

Ahmed Abdelghany, Associate Professor, Embry-Riddle, Daytona Beach, FL, 32114, United States of America, abdel776@erau.edu, Khaled Abdelghany

We present an optimization model for airline schedule planning. Given the flight frequency in every city-pair, the model determines the optimal departure time for each proposed flight. The model considers the trade-off among maximizing the airline's market share, establishing efficient aircraft rotations, and minimizing aircraft ground time.

3 - Reducing Airport Gate Blockage in Passenger Aviation: Models and Analysis

Jeremy Castaing, PhD Student, University of Michigan, 1205 Beal Avenue, Ann Arbor MI 48109-2117, United States of America, jctg@umich.edu, Amy Cohn, Ishan Mukherjee

A Gate blockage occurs when a flight arrives to its scheduled gate but has to wait because an aircraft is still occupying it. We formulate an optimization problem to assign flights to gates so as to minimize the expected impact of gate blockage. We use historical data to predict delay distributions and conduct experiments to assess both the computational tractability of our approach and its potential for improvement in solution quality over existing approaches.

4 - A Graph-based Formulation for the Shift Rostering Problem

David S.W. Lai, Ph.D. student, Systems Engineering & Eng. Mgt. Dept., CUHK, Shatin, New Territories, Hong Kong, Hong Kong - PRC, swlai@se.cuhk.edu.hk, Janny Leung

This paper addresses a shift rostering problem where the work rules are expressed in terms of prohibited meta-sequences and resource constraints. A graph-based formulation is proposed where the feasible shift patterns are represented by the paths of a graph. The formulation size depends on the structure of the work-rule constraints and is independent of the number of staff. This is particularly beneficial when the work rules possess sufficient structure that results in a small formulation.

■ SC71

Mezzanine -101B

Delay Propagation in Aviation Networks - Empirical Observations and Models

Sponsor: Aviation Applications

Sponsored Session

Chair: Lavanya Marla, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Avenue, 216E, Urbana, IL, 61801, United States of America, lavanyam@illinois.edu

1 - Robust Aircraft Routing

Mazhar Arikan, Assistant Professor, University of Kansas, School of Business, Lawrence, KS, United States of America, mazhar@ku.edu, Vinayak Deshpande, Milind Sohoni

In this paper, we develop an approach to reroute aircraft that minimizes the total stochastic propagated delay. We complement this analysis with a study that reallocates block times across the network of an airline by considering the new routings of aircraft and analyze the trade-off between total network arrival delay minutes and network-wide block-time budget.

2 - Data-driven Models for Robust Aircraft Routing

Lavanya Marla, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Avenue, 216E, Urbana, IL, 61801, United States of America, lavanyam@illinois.edu, Cynthia Barnhart, Vikrant Vaze

In this work, we investigate the types of delay distributions that aircraft incur as they travel on their routes. From an extensive data set, we discuss our empirical findings about distributions of delays propagating on possible aircraft routes or paths. We further discuss the reasons for such delay patterns. We conclude with models and frameworks that can capture such patterns effectively and produce solutions that mitigate these delays.

3 - An Integrated Disruption Recovery Approach with Passenger Recovery and Cruise Speed Decisions

Ugur Arikan, Research Assistant, Middle East Technical University, Universiteler Mh, Dumlupinar Blv, No:1, Ankara, 06800, Turkey, arikanu@metu.edu.tr, Sinan Gurel, M. Selim Akturk

We propose a new network-flow based model for the integrated airline disruption recovery problem. We consider detailed passenger recovery and cruise speed decisions along with other well-known aircraft and crew recovery actions. We propose a mixed integer conic quadratic programming formulation solved in reasonable CPU times for practical size problems.

■ SC72

Mezzanine -101C

Analytics Maturity Model

Cluster: INFORMS Communities

Invited Session

Chair: Barry List, Director of Communications, INFORMS, Catonsville, MD, 21076, United States of America, barry.list@informs.org

1 - Introducing the INFORMS Analytics Maturity Model for Improving Organizational Decision Support

Norm Reitter, Senior Director, Analytics, Syngineering, LLC, 1892 Denver West Court, Denver, CO, 80401, United States of America, norm@reitter.net

Decision makers need assurance that their analytics supports their objectives. INFORMS has developed an analytic maturity model (AMM) designed to help organizations assess themselves, set goals, and justify investments to support improvements. This presentation will provide an overview of the INFORMS AMM and the approach that INFORMS is taking to help members improve organizational conditions, analytical capabilities, and data support to achieve greater business and military outcomes.

2 - Analytics Maturity Model
Barry List, Director of Communications, INFORMS, Catonsville, MD, 21076, United States of America, barry.list@informs.org

How analytically mature is your company or organization? As part of its strategic planning and analytics initiative, an ad hoc committee is designing an interactive INFORMS Analytics Maturity that will be made available on the INFORMS website. It will allow you to examine three key aspects of your company/government agency/non-profit • Important characteristics of the organization (the impact of leadership, its people, key metrics/measures, and business processes) • Its analytic capabilities (analytic framework, roles & skills, analytic services, and analytic processes) • Data and infrastructure (data "health," access, traceability, and analytic architecture) This session will preview the model and explain how it will work, how you can access it when it goes live, and how you can make it available to colleagues at your company and at other organizations. The committee chair, Norman Reitter of Syngineering, and INFORMS Communications Director Barry List will provide this first preview and explain how you can incorporate the model into your work.

Sunday, 4:30pm - 6:00pm

■ SD01

Level 2 - Room 200A

Portfolio Optimization I

Cluster: Optimization in Finance

Invited Session

Chair: Nikos Trichakis, Harvard University, Boston, MA, United States of America, ntrichakis@hbs.edu

Co-Chair: Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu

1 - Fairness and Efficiency in Multiportfolio Optimization
Nikos Trichakis, Harvard University, Boston, MA, United States of America, ntrichakis@hbs.edu, Dan Iancu

When a manager is in charge of multiple accounts, the performance of each account depends on the strategies of others due to market impact. We propose a novel approach for jointly optimizing the trading activities of all accounts and also splitting the associated market impact costs. Our approach allows one to balance the conflicting objectives of maximizing aggregate gains and distributing them fairly. We perform numerical studies that suggest that our approach outperforms existing methods.

2 - The Impact of Monitoring and Covenants in Asset-based Lending
Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu, Nikos Trichakis, Gerry Tsoukalas

In order to mitigate default risk, lenders impose covenants on borrowers and monitor their performance over time. We analyze the impact of such covenants and monitoring on the strategic interactions between borrowers and lenders in the retail asset-based lending industry. We find that covenants can be a double-edged sword: while they provide additional insurance to lenders, they can also adversely impact the borrowers' capacity investments, impeding supply-chain coordination.

3 - Blind Auctions and Predatory Trading
Gerry Tsoukalas, University of Pennsylvania, Wharton School, Philadelphia, PA, United States of America, gtsouk@wharton.upenn.edu

We analyze the blind auctions market in which a seller solicits private off-market bids for her portfolio. Fearing predation, the seller often runs the auction blind, in the sense that the underlying assets are only revealed ex-post to the winner. We study the secrecy vs. efficiency trade-off that ensues and characterize the optimal amount of information dissemination to the market. We show specific conditions under which transparency can be optimal, despite predatory behavior.

■ SD02

Level 2 - Room 200B

Optimization Software and Applications

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Hans Mittelmann, Arizona State University, Box 871804, Tempe, AZ, United States of America, Mittelmann@asu.edu

1 - Automatic Algorithm Selection for Nonlinear Optimization Problems
Zsolt Csizmadia, FICO, FICO House, Starley Way, Birmingham, B37 7GN, United Kingdom, ZsoltCsizmadia@fico.com

Performance of nonlinear optimization problems depend on the solution method used, a nontrivial selection requiring expert knowledge. The best modeling practice has traditionally been to keep the solution methods available in mind, limiting the freedom of the modeler. The talk will discuss problem characteristics that may guide the automatic selection of the best fitting method including identification of special problem classes, presolve and deciding between first and second order methods.

2 - Tour de MOSEK 7: The Short Version
Erling Andersen, CEO, MOSEK ApS, Fruebjergvej 3, Box 16, DK-2100, Copenhagen, Denmark, e.d.andersen@mosek.com

We present the new features in MOSEK version 7. These features includes support for semi-definite optimization, a new API for building conic optimization models easily and a new mixed-integer optimizer. Finally, we will discuss the expected performance improvements from upgrading from version 6 if time permits.

3 - Exact and Heuristic Approaches for Directional Sensor Control
Hans Mittelmann, Arizona State University, Box 871804, Tempe, AZ, United States of America, MITTELMANN@asu.edu, Domenico Salvagnin

The Directional Sensor Control problem (DSCP) consists in assigning a direction of view to each sensor with the goal of maximizing information gain on the location of a given set of target objects. In this paper we study and computationally evaluate exact and approximate approaches for the DSCP. In particular, we propose an exact mixed integer convex programming (MICP) formulation and several meta-heuristic approaches.

4 - Mixed Integer Programming: Analyzing 12 Years of Progress
Roland Wunderling, IBM, Annenstrasse 9, Graz, 8020, Austria, roland.wunderling@at.ibm.com, Tobias Achterberg

In this talk we outline an unbiased way to analyze benchmark results and apply this scheme to assess the contribution of the main components in CPLEX 12.5 to the ability to solve MIPs. We highlight some of the more recent features, in particular the deterministic parallel optimizer.

■ SD03

Level 2 - Room 200C

New Methods for MINLP

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Andrea Cassioli, Ecole Polytechnique, Route de Saclay, Palaiseau, 91128, France, cassioli@lix.polytechnique.fr

1 - Bounding the Range of Implicit Functions
Paul I Barton, Massachusetts Institute of Technology, Process Systems Engineering Laboratory, 77 Massachusetts Ave., Rm 66-464, Cambridge, MA, 02139, United States of America, pib@mit.edu, Achim Wechsung

Deterministic global optimization methods are known to scale worst-case exponentially with the number of variables. Reduced-space approaches attempt to counter this by reducing the number of variables branched on, e.g., by using equality constraints to define implicit functions. In light of the cluster effect, it is important to bound their range using methods that have quadratic convergence order. Here, we present recent advances designed with this key property in mind.

2 - New Under-estimators for Box Constrained Integer Polynomial Optimization

Claudia D'Ambrosio, Ecole Polytechnique, Palaiseau Cedex, 91128, France, dambrosio@lix.polytechnique.fr

We consider the problem of minimizing an arbitrary polynomial subject to box and integrality constraints. We propose a new class of under-estimators composed of separable functions of the original variables and use it within a branch-and-bound scheme to easily and quickly compute lower bounds. Computational results on randomly generated instances show good performance with respect to the ones of different open-source solvers.

3 - An Integrality Gap Minimization Algorithm for Binary Mixed Integer Nonlinear Programming

Wendel Melo, Visiting Scholar, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, wendelalexandre@gmail.com, Fernanda Raupp, Marcia Fampa

This work presents a new algorithm for binary Mixed Integer Nonlinear Programming (MINLP) problems based on the idea of minimizing the integrality gap. To improve feasible solutions, a sequence of convex and nonconvex nonlinear programming subproblems is solved. Computational experiments have shown that the proposed algorithm can find feasible solutions of the original problem very fast, showing a promising feasibility heuristic.

■ SD04

Level 2 - Room 200D

Cutting planes in MINLP

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Akshay Gupte, Assistant Professor, Clemson University, Martin Hall, Dept. of Math Sciences, Clemson University, Clemson, SC, 29634, United States of America, agupte@clemson.edu

1 - Split Cuts and Extended Formulations for Second-order Conic Programming

Sina Modaresi, University of Pittsburgh, Pittsburgh, PA, United States of America, sim23@pitt.edu, Mustafa Kilinc, Juan Pablo Vielma

We study split cuts for second-order conic programming and introduce several extended formulations to which we can add the split cuts. We show how using an extended formulation might provide an advantage on generating cuts. We also compare the computational effectiveness of the split cuts and conic mixed-integer rounding cuts proposed by Atamturk et al. on different extended formulations.

2 - MILP Approaches for a Class of Mixed Integer Bi-level Programming Problems

Mahdi Hamzeei, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, hamzeei@wisc.edu, James Luedtke

We consider a class of mixed integer bilevel programming problems motivated by a facility location problem with queueing delay considerations. We formulate a mixed-integer bilevel programming problem and derive mixed-integer linear programming approximations of the problem. We also investigate ways to strengthen the resulting MILP formulations. Numerical results will demonstrate the performance of the approach.

3 - Cardinality Constrained Linear Program: Facial Disjunctive Formulation and Valid Inequalities

Jinhak Kim, Purdue University, 403 W State st. Room B031A, West Lafayette, IN, 47907, United States of America, kim598@purdue.edu, Mohit Tawarmalani, Jean-Philippe Richard

We use a ratio of multilinear terms as product factors to generalize RLT to problems with cardinality constraints. Using this approach we develop relaxation schemes that converge to the convex hull of solutions when the feasible region is compact. We also consider specially structured problems such as cardinality constraint with a single linear constraint. We develop valid inequalities using lifting techniques. We identify conditions under which these inequalities are facet-defining.

■ SD05

Level 2 - Room 200E

Recent Developments in Solving Network Flow Models and TSP

Sponsor: Optimization/Networks

Sponsored Session

Chair: Qie He, University of Minnesota, 111 Church Street SE, Minneapolis, MN, United States of America, qie.he@gatech.edu

1 - Improving Christofides' Algorithm for the s-t Path Traveling Salesman Problem (TSP)

David Shmoys, Professor, Cornell University, 231 Rhodes Hall, 136 Hoy Road, Ithaca, NY, 14853, United States of America, david.shmoys@cornell.edu, Robert Kleinberg, Hyung-Chan An

We present an approximation algorithm for the metric -t path TSP (the path variant that connects two specified endpoints), which is guaranteed to find a solution of cost within a factor of the golden ratio of optimal in polynomial time. Christofides is a 5/3-approximation algorithm for this problem, and no prior improvements were known. We modify this algorithm so that it chooses the initial spanning tree based on an optimal solution to a natural LP relaxation, surpassing the 20-year-old bound.

2 - A Contraction-expansion Algorithm for the Capacitated Minimum Cost Network Flow Problem

Jacques Desrosiers, Professor, HEC Montréal and GERAD, 3000 Cote-Sainte-Catherine, Montreal, Qc, H3T2A7, Canada, jacques.desrosiers@gerad.ca, Jean-Bertrand Gauthier, Marco E. Luebbecke

The Improved Primal Simplex (IPS) only makes non-degenerate pivots while solving LPs. Hence it takes a finite number of iterations on integral data network flow problems. We show that IPS is strongly polynomial for the assignment and the shortest path problems. Moreover, with a slight modification, it becomes strongly polynomial for solving the capacitated minimum cost network flow problem. The algorithm is similar to the minimum mean cycle-cancelling algorithm of Goldberg and Tarjan (1989).

3 - Minimum Concave Cost over a Grid Network

Qie He, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, qhe@umn.edu, George Nemhauser, Shabbir Ahmed

We study a min concave cost network flow problem over a grid network, which has vertices corresponding to a two-dimensional square lattice and horizontal and vertical arcs. In many applications, one dimension of the network models the temporal dynamics and the other models the spatial locations (echelons). We propose a polynomial-time algorithm to solve this problem when the number of echelons is fixed. We show that the problem is NP-hard when the number of echelons is an input parameter.

4 - Multi-commodity Network Flow Problems with Substitution

Guvenc Sahin, Associate Professor, Sabanci University, Orhanli, Tuzla, Istanbul, 34956, Turkey, guvencs@sabanciUniversityedu, Ekin Koker

Multi-commodity network flow problem generalizes the single commodity problem. Integrality conditions together with arc capacities make the problem NP-complete. A new variant of the multi-commodity problem includes substitution possibilities amongst commodities. We investigate capacitated and uncapacitated versions for their unimodularity properties and computational complexities. We also present a computational study to empirically observe what makes the problems harder to solve.

■ SD06

Level 2 - Room 200F

Recent Advances in Conic Optimization II

Sponsor: Optimization/Linear Programming and Complementarity

Sponsored Session

Chair: Mohammad Oskoorouchi, California State University, San Marcos, 333 Twin Oaks Valley Rd., San Marcos, CA, 92096, United States of America, moskooro@csusm.edu

1 - Linear and Second Order Approximations to the SOS Cone

Amir Ali Ahmadi, Goldstine Fellow, IBM Watson Research Center, 1101 Kitchawan Rd., Yorktown Heights, NY, United States of America, a_a_a@mit.edu, Anirudha Majumdar

We present linear and second order inner approximations to the sum of squares (SOS) cone and new hierarchies for polynomial programs that are considerably more scalable than the SOS hierarchies.

2 - A Deterministic Rescaled Perceptron Algorithm
Negar Soheili Azad, PhD Candidate, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, nsoheili@andrew.cmu.edu, Javier Pena

The classical perceptron algorithm is a separation-based algorithm for solving conic-convex feasibility problems in a number of iterations that is bounded by the reciprocal of the square of the cone thickness. We propose a modified perceptron algorithm that leverages periodic rescaling for exponentially faster convergence, where the iteration bound is proportional to the logarithm of the reciprocal of the cone thickness and another factor that is polynomial in the problem dimension.

3 - Exact Computable Representation of Some Second-order Cone Constrained Quadratic Optimizations
Qingwei Jin, Assistant Professor, Zhejiang University, Department of Management Science and Eng, Hangzhou, 310058, China, qingweijin@gmail.com, Shu-Cherng Fang, Ye Tian, Wenxun Xing

Solving the quadratically constrained quadratic programming (QCQP) problem is in general NP-hard. Only a few subclasses of the QCQP problem are known to be polynomial-time solvable. We provide exact computable representations for some more subclasses of the QCQP problem, in particular, the subclass with one second-order cone constraint and two special linear constraints.

4 - Convex Sets as Invariant Sets for Linear Systems
Yunfei Song, Lehigh University, 337 S. New St., Apt. 202, Bethlehem, PA, 18015, United States of America, yus210@lehigh.edu, Tamas Terlaky

We propose a novel, unified, general approach to analyze sufficient and necessary conditions under which polyhedra, polyhedral cones, ellipsoids, or Lorenz cones are invariant sets for a linear continuous or discrete system. We show that the forward Euler method preserves positive invariance for polyhedra or polyhedral cones, while the backward Euler method preserves positive invariance for all the four sets.

■ SD07

Level 2 - Room 200G

Multiobjective Probabilistic Programming

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Miguel A. Lejeune, George Washington University, Duques Hall, Room 406, Washington, DC, United States of America, mlejeune@gwu.edu

1 - Rapidly Detecting an Anomaly Spreading Stochastically on a Network
David Morton, The University of Texas at Austin, Austin, TX, 78712, United States of America, morton@mail.utexas.edu, John Hasenbein, Jinho Lee

We consider an anomaly that spreads according to stochastic dynamics on a network. Subject to a budget constraint, we install sensors on nodes of the network to maximize the probability we detect the anomaly by a time threshold. Using a Monte Carlo approximation of a stochastic integer program, we solve large-scale problem instances using data from a cellphone service provider.

2 - Probabilistic Constrained Multiobjective Programming — Models and Formulations: Part I
Miguel A. Lejeune, George Washington University, Duques Hall, Room 406, Washington, DC, United States of America, mlejeune@gwu.edu, Siqian Shen

We study probabilistically constrained multiobjective stochastic programming problems. We use a Boolean programming method to derive a series of equivalent deterministic mixed-integer programming formulations. The method applies to all types of chance constraints, including the joint probabilistic constraints with random technology matrix and random right-hand sides.

3 - Robust Weight Optimization of Return and Reliability in Multi-Portfolio Optimization
Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu, Zhihao Chen, Miguel A. Lejeune

Management of risk through multiple chance constraints requires proper weighing of cost against virtual reward gained from reliability satisfaction. We derive robust solutions given uncertain weights (decision preferences) of return and reliability in a multi-portfolio optimization problem with joint/multiple chance constraints. We bound feasible weights within a box and use MIP techniques. Both computational and managerial results are provided.

■ SD08

Level 2 - Room 200H

Progressive Hedging for Stochastic Unit Commitment

Sponsor: Computing Society

Sponsored Session

Chair: David Woodruff, University of California-Davis, Graduate School of Management, Davis, CA, 95616, United States of America, DLWoodruff@UCDavis.edu

1 - Upper and Lower Bounding Strategies with Progressive Hedging for Stochastic Unit Commitment
Jean-Paul Watson, Sandia National Laboratories, PO Box 5800, MS 1326, ALbuquerque, NM, 87185-1326, United States of America, jwatson@sandia.gov, David Woodruff

We describe a variety of algorithmic strategies for efficient lower and upper bounding of large-scale stochastic unit commitment problems via the Progressive Hedging algorithm. Upper bounding techniques include rho setting, bundling, and asynchronous computation. The tuning of newly developed lower bounding techniques for Progressive Hedging will also be discussed.

2 - Progressive Hedging for Stochastic Economic Dispatch with AC Power Flow
John Siirola, Sandia National Laboratories, Albuquerque, NM, United States of America, jdsiiro@sandia.gov, Jean-Paul Watson, Cesar A. Silva-Monroy, Zev Friedman

In practice, the economic dispatch (ED) problem (setting min-cost generation levels in an electrical grid) is approximated as a deterministic linear program. However, especially with high renewables penetration, the real problem is both stochastic and non-linear. We investigate the use of progressive hedging to solve stochastic, non-linear ED with AC power flow. Computational experiments on standard IEEE benchmarks are discussed, in addition to parallelization on modest-scale compute clusters.

3 - A New Lower Bound from Progressive Hedging
Sarah Ryan, Iowa State University, Black Hall, Ames, United States of America, smryan@iastate.edu, Dinakar Gade

Nonconvexity and/or a restrictions on computation time may cause the progressive hedging (PH) algorithm to terminate with a feasible solution and a cost upper bound. A tight lower bound can provide reassurance on the quality of the PH solution. We describe a new method to obtain lower bounds using the information prices generated by PH. We show empirically, using these lower bounds, that for large-scale non-convex stochastic unit commitment problems, PH generates very good solutions.

■ SD09

Level 2 - Room 200I

Innovative Applications In Analytics: 2013 Winner Reprise

Sponsor: Analytics Section

Sponsored Session

Chair: Michael Gorman, Professor, University of Dayton, 300 College Park, Dayton, OH, 45469, United States of America, michael.gorman@udayton.edu

1 - Analytics Section: History
Zahir Balaporia, Director, Intermodal Operations, Schneider National, 3101 S. Packerland Drive, Green Bay, WI, 54313, United States of America, balaporiaz@schneider.com

Zahir will provide a brief background and overview of activities of the INFORMS Analytics Section.

2 - Innovative Applications in Analytics Award: History
Michael Gorman, Professor, University of Dayton, 300 College Park, Dayton, OH, 45469, United States of America, michael.gorman@udayton.edu

Mike will recount the 2-year history of the Innovative Applications in Analytics Award, describing the philosophy of the award, and the history of submissions and finalists.

3 - Machine Learning for Power Grid Reliability: Predicting Manhole Events in New York

Cynthia Rudin, Assistant Professor, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, 02142, United States of America, rudin@mit.edu

I will present innovations in proactive power grid maintenance stemming from a collaboration between Columbia University and Con Edison, NYC's power utility company. Specifically, I will describe the Manhole Events Project, where the goal is to predict electrical failures, including manhole fires and explosions in New York City. I will discuss the data mining process by which we transformed extremely raw historical data into a ranking model that predicts manhole vulnerability. Our ranked lists are currently assisting with the prioritization of future inspections and repairs in Manhattan, Brooklyn, and the Bronx.

4 - Innovative Applications in Analytics Award: 2013-2014 Preview of Semifinalists

Pooja Dewan, General Director, Burlington Northern Santa Fe Corporation, 2400 Western Center, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

Pooja will give a brief introduction to the 2013-2014 award competition, the semifinalists of which will be presenting in subsequent sessions.

■ SD10

Level 2 - Room 200J

2013 INFORMS Prize Winner: Ford Motor Company

Cluster: INFORMS 2013 Prize

Invited Session

Chair: Stefan Karisch, Director, OR & Optimization, Jeppesen, 55 Inverness Drive East, Englewood, CO, 80112, United States of America, stefan.karisch@jeppesen.com

1 - Ford Motor Company Transforms Its Business using OR and Analytics

Erica Klampfl, Technical Leader, Ford Motor Company, 2101 Village Road, Dearborn, MI, United States of America, eklampfl@ford.com

Ford was awarded the INFORMS Prize for extensive and sustained use of operations research (OR) and analytics throughout its business. We will describe the importance of OR and analytics to Ford's past, present, and future and how OR helped during our transformation in a competitive environment, a crashing economy, and fast-changing market conditions. We will provide an overview of OR and analytics at Ford and highlight some key projects that have transformed our business.

■ SD11

Level 2 - Room 201A

Joint Session Telecom/Inform-ED: NSF TUES Grants in Telecommunications Education

Sponsor: Telecommunications & Inform-ED

Sponsored Session

Chair: Abdullah Konak, Professor of Information Sciences and Technology, Penn State Berks, Tulpehocken Road, PO Box 7009, Reading, PA, 19610, United States of America, konak@psu.edu

1 - Collaborative Research: Stochastic Challenge

Timothy Matis, Texas Tech University, Department of Industrial Engineering, Box 43061, Lubbock, TX, 79409, United States of America, timothy.matis@ttu.edu

This presentation will describe the educational research activities associated with the NSF-sponsored project "Collaborative Research: Stochastic Challenge", a collaborative research project between the Texas Tech University, Missouri University of Science and Technology and the University of Texas – Pan American. We will describe how these tools may be of use to Operations Research students and professionals interested in Telecommunications applications.

2 - Stochastic Challenge: Computational Tools from Inference to Prediction

Ivan Guardiola, Assistant professor, Missouri S&T, 600 W. 14th Street, Rolla, MO, 65401, United States of America, guardiolai@mst.edu

This presentation highlights the online calculators developed as part of an NSF-TUES sponsored educational grant. These calculators allow for online execution without the need of coding or software downloading and installation. The calculators include computations common to stochastic processes course or probabilistic modeling courses. The calculators include topics such as discrete time markov chains, continuous time markov chains, statistical testing.

3 - Impact of Collaborative Work on Student Learning in a Virtual Computer Laboratory

Michael R. Bartolacci, Pennsylvania State University, 217 Gaige Building, IST, Room G217, Reading, PA, 19610, United States of America, mrb24@psu.edu, Abdullah Konak

We study the impact of collaborative work on student learning using controlled experiments in an innovative virtual computer laboratory for teaching telecommunications and information security technologies. In this paper, we are investigating how to best utilize the virtual computers for teaching information security debating such issues as whether learning is greater when exercises are conducted in groups or as individuals.

4 - Enhancing Student Learning in Virtual Computer Laboratories through Experiential Learning

Abdullah Konak, Professor of Information Sciences and Technology, Penn State Berks, Tulpehocken Road, PO Box 7009, Reading, PA, 19610, United States of America, konak@psu.edu, Tricia Clark, Mahdi Nasereddin

This paper argues that hands-on activities designed based on a prescriptive, step-by-step approach do not always achieve the expected learning outcomes. Kolb's Experiential Learning Cycle is proposed as a framework to design hands-on activities for virtual computer laboratories. Empirical results are reported from two studies involving 169 students to test the effectiveness of the proposed framework.

■ SD12

Level 2 - Room 201B

Nicholson Student Paper Competition: Finalists II

Cluster: Nicholson Student Paper Prize

Invited Session

Chair: Huseyin Topaloglu, Cornell University, Frank H T Rhodes Hall, Ithaca, NY, 14853, United States of America, ht88@cornell.edu

1 - Nicholson Student Paper Prize

Jose Blanchet, Professor, Columbia University, 500W 120th Street, New York, NY, United States of America, jose.blanchet@columbia.edu, Huseyin Topaloglu

The top participants in the Nicholson student paper competition are selected as finalists by the prize committee and invited to present their work in these sessions. This competition comprises papers of the highest quality drawn from virtually all areas represented by INFORMS.

■ SD13

Level 2 - Room 202A

Process and Product Design Choices in Furthering Innovation

Cluster: New Product Development

Invited Session

Chair: Sriram Narayanan, Assistant Professor, Michigan State University, N357 College of Business Building, Michigan State University, East Lansing, MI, 48824, United States of America, narayanan@bus.msu.edu

1 - Collocation Matters: Conformance Quality and the Interdependence of R&D and Manufacturing

Enno Siemsen, Associate Professor, University of Minnesota, 3-150 Carlson School of Management, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu, Gurneeta Vasudeva, John Gray

This study investigates the manufacturing conformance quality benefits of collocating manufacturing units with research and development (R&D) activities using a large panel dataset of U.S. based pharmaceutical plants. The benefits of collocation are stable throughout the time period studied, which is surprising given the rapid development of advanced communication technologies in that period. However, the benefits of collocation are contingent on certain firm- and plant-specific characteristics.

2 - Selling New Products to Strategic Customers with Learning Externality

Yufei Huang, PhD Student, University College London, Gower Street, London, WC1E 6BT, United Kingdom, yufei.huang.10@ucl.ac.uk, Bilal Gokpinar, Onesun Yoo

We study a seller's optimal pricing strategy and capacity decision when selling a new/innovative product to risk-averse customers who are uncertain about their valuations. Customers are strategic, who may deliberately delay their purchase for a lower price or more information from other customers to reduce their valuation uncertainty. We then analyse the effect of learning externality on the seller's pricing strategy and capacity decision.

3 - Product and Supply Base Complexity: Implications for Cost

Mark Jacobs, Assistant Professor, University of Dayton, 300 College Park, Dayton, OH, 45469, United States of America, majacobs@udayton.edu, Morgan Swink

Explicit and implicit links between product and supply chain structure are suggested in the literature, but to date remain untested empirically. Using primary data from the automotive sector this manuscript investigates the impact of product structural complexity and supply base complexity from the perspective of Transaction Cost Economics. Empirically revealed is the role of agency in prices paid by buyers and the cost implications of product architectural design choices.

4 - Utilization of External Knowledge Resources: How Much Does Firm Scope Matter?

Sriram Narayanan, Assistant Professor, Michigan State University, N357 College of Business Building, Michigan State University, East Lansing, MI, 48824, United States of America, narayanan@bus.msu.edu, Nandini Lahiri

We examine how firms differ in utilizing partner knowledge resources in high technology industry. We show that the degree to which the focal firm is able to utilize partners technological and knowledge distribution is heterogeneously determined by the scope of firm's own geographic and technological distribution.

■ SD14

Level 2 - Room 202B

Assessing Supply Chain Risks and Building Resilience

Cluster: Managing Disruptions in Supply Chain

Invited Session

Chair: Cameron MacKenzie, Assistant Professor, Naval Postgraduate School, Monterey, CA, United States of America, camacken@nps.edu

1 - Metrics for Risk and Resilience

Igor Linkov, US Army Engineer Research & Development Center, 696 Virginia Road, Concord, MA, United States of America, Igor.Linkov@usace.army.mil, Zachary Collier

Our increasingly complex decision-making environment is characterized by uncertainty regarding future events including natural hazards and man-made accidents, requiring a need for resilient systems. In order to design and manage resilience, there must be assessment of resilience (analytically derived through a set of key metrics). This presentation contrasts risk and resilience, and offers techniques leveraged from the field of Multi-Criteria Decision Analysis for quantifying resilience.

2 - A System Dynamics Framework for Smart Grid Supply Chain Disruption

Shokoufeh Mirzaei, Assistant Professor, California State Polytechnic University, 3801 W Temple Ave., Pomona, CA, 91768, United States of America, smirzaei@csupomona.edu

This paper investigates the dynamics of smart grid supply chain and its potential disruption scenarios. First, major components of smart grid supply chain are identified. Then, a model-based system dynamics framework is developed and the potential risk factors and their associated risks are identified. The framework will enable managers to track the impact of the risk factor in the system and to build proactive and reactive strategies.

3 - Deploying Simulation to Compare Among Different Risk Reduction Strategies for Supply Chains

Cameron MacKenzie, Assistant Professor, Naval Postgraduate School, Monterey, CA, United States of America, camacken@nps.edu

A firm can choose among several strategies to reduce the risk of disruptions in its supply chain, including holding inventory, buying from multiple suppliers, and helping suppliers recover. Because these risk management strategies may be non-continuous and depend on each other, simulation can be used to select a near optimal combination of strategies. We develop a conceptual framework for a firm who wishes to select resilience strategies that maximize its profit.

4 - Cyber-armor: Analyzing the Risk of Vulnerabilities Introduced into a Supply Chain

Marshall Kuypers, Stanford, 10124 Lindsay lane, Mokena, IL, 60448, United States of America, marshallkuypers@gmail.com, Philip Martin, Jack Smith, Elisabeth Pate-Cornell, Katie Ward, Gregory Heon

The possibility of an intentional attack using a vulnerability introduced through a component's supply chain has recently gained attention. Organizations are struggling with tough decisions regarding how to best evaluate the risk of different products that are an integral part to their network security. In this talk, we discuss several strategies for managing the risk of cyber-attacks and provide a case study on an enterprise style firewall.

■ SD15

Level 2 - Room 203

Panel Discussion: Complexity in Designing Service

Sponsor: Service Science

Sponsored Session

Chair: Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 23060, United States of America, ralphb@vt.edu

Co-chair: Ruoyi Zhou, ruoyi@us.ibm.com

1 - Panel Discussion: Complexity in Designing Service

Moderator: Ralph Badinelli, Professor, Virginia Tech, Dept. of Business Information Technology, Virginia Tech 0235, Blacksburg, VA, 23060, United States of America, ralphb@vt.edu, Panelists: Ray Strong, Sechan Oh

This panel represents both an academic and an industry view of the challenges to service innovation that are posed by the inherent complexity of context-dependent service environments. Each panel discussant will make a short presentation on this topic. The moderator will then stimulate a discussion on several key questions about complexity in service. The audience will be encouraged to engage in questions and comments.

■ SD16

Level 2 - Room 204

Measuring Health Outcomes

Sponsor: Health Applications

Sponsored Session

Chair: Evin Jacobson, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, United States of America, wqm4@cdc.gov

1 - A Service Quality Perspective on Staff Schedules in Hospitals

Felix Miedaner, University of Cologne, Albertus Magnus Place, Cologne, Germany, felix.miedaner@uni-koeln.de, Ludwig Kuntz

Recent research indicates that decisions on staff schedules not only influence costs, but also staff behavior and medical outcomes. We complement this research by identifying structures of staff schedules which are linked to treatment quality. Specifically, we ask whether staffing levels and daily staffing changes are associated with medical outcomes. We report on the results of a pilot study in two neonatal intensive care units.

2 - Cost Effectiveness of Improving Retention in Care for HIV-infected Persons in the United States

Yu Teng, Centers for Disease Control and Prevention, 1600 Clifton Rd. NE, MS E-36, Atlanta, GA, 30333, United States of America, wqp0@cdc.gov, Paul G. Farnham, Stephanie Sansom

Antiretroviral treatment(ART) for HIV dramatically improves the life expectancy of those infected and reduces the risk of transmission, but achieving those results requires that people with HIV stay in care and on treatment. We examine the effect and cost-effectiveness of strategies to promote retention in care and adherence to medications using the Progression and Transmission of HIV/AIDS (PATH) model, an agent-based simulation model that tracks individual disease progression and transmissions.

3 - From Theory to Practice: A Resource Allocation Model for Health Departments

Emine Yaylali, PE Fellow, Centers for Disease Control and Prevention, 1600 Clifton Road NE, MS E-36, Atlanta, GA, 30333, United States of America, wqq3@cdc.gov, Arielle Lasry, Stephanie Sansom

Resource allocation models can synthesize surveillance, programmatic and research data in a transparent way to guide the optimal distribution of a fixed budget among people and programs. Although a number of resource allocation models for HIV prevention have been created over the years, they seldom are used in practice. In this study, we describe the challenges of designing and executing an HIV resource allocation model for state and local health departments.

4 - The Complexity of Creating a National Health Security Preparedness Index

Evin Jacobson, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, United States of America, wqm4@cdc.gov

With input from more than 25 stakeholder organizations, the developmental draft of the National Health Security Preparedness Index was shared with states for feedback on April 2, 2013. The Index contains 120 candidate measures from 35 data sources. We analyze the complex process of rolling measures together to give a single value. Particularly we focus on statistical challenges such as determining outliers and weights for the measures as well as satisfying independence and normality assumptions.

■ SD17

Level 2 - Room 205A

Service Science

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, Distinguished Professor, National Taiwan University, 1, Sec. 4, Roosevelt, Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw

1 - Service Science, Human Resources, Information Systems and Information Distortion Interactions

Orhan Güvenen, Professor, Bilkent University, Bilkent University DSEE, FEASS, Z-03 06800 Bilkent, Ankara, Turkey, gorhan@bilkent.edu.tr

In service science applications optimization, endogenization of the following subsystems can be considered as complementary conditions: (i) Transdisciplinary science methodology, (ii) "Third Generation University" impact on human resources, (iii) Information systems and information distortion interactions. This paper analyses the interactions of the mentioned subsystems.

2 - Empirical Bug Analysis in Apache Virtual Computing Lab

Rahul Ghosh, Advisory Software Engineer, IBM, 4205 South Miami Blvd, Durham, NC, 27703, United States of America, rghosh@us.ibm.com, Flavio Frattini, Marcello Cinque, Andy Rindos, Stefano Russo, Kishor Trivedi

Open source Cloud software stacks (e.g., OpenStack, Apache VCL) have recently gained significant attention both from industry and academia. Understanding the software bugs in such Cloud platforms is an important but rarely investigated issue till date. We performed an analysis of the reported bugs in Apache VCL. Results help in identifying the defect prone components and phases in Cloud and assist in the software testing and debugging stage.

3 - Operational Analytics and Their Application in Application Management Service (AMS)

Ying Li, Research Staff Member, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, yingli@us.ibm.com, Ta-Hsin Li, Jeaha Yang, Rong Liu, Juhnyoung Lee

In AMS business, organizations could spend as much as 80% of their application budgets on maintenance-related activities, which are faithfully captured by application-based problem tickets. We will discuss a set of recently developed operational analytics for mining the wealthy information contained in these tickets including ticket volume and resolution time trend analysis, backlog monitoring, resource utilization analysis, volume forecasting, group right-sizing and what-if scenario analysis.

4 - The Service Information Transformation

Ming-Hui Huang, Distinguished Professor, National Taiwan University, 1, Sec. 4, Roosevelt, Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw

We observe that IT is shaping service in two directions: IT transforms service that makes it more tangible (integrated solutions), separable (e-services), homogeneous (automation), and storable (cloud computing); whereas IT also renovates manufacturing sectors to be servitized (intangibility), engage customers deeper through participation (inseparability), customize individual customers' needs (variability), and incorporate time, not just price, as an important consideration (perishability).

■ SD18

Level 2 - Room 205B

Public Service

Sponsor: Service Science

Sponsored Session

Chair: Arthur J. Swersey, Professor of Operations Research, Yale School of Management, Box 20820, New Haven, Ct, 06520, United States of America, arthur.swersey@yale.edu

1 - Bayesian Updating in Educational Testing

Douglas Jones, Professor, Rutgers Business School, One Washington Park, Room 1058, Newark, NJ, 07102, United States of America, dhjones@rci.rutgers.edu

Educational testing agencies in the US must provide new test norm information every few years in States in order to provide tests in the K-12 learning assessments. This contrasts with the former requirement of new test norms every 10 years, and is a potentially expensive undertaking. This talk will explore Bayesian methods to use prior tests norms to update current client score data to provide the required new test norms.

■ SD19

Level 2 - Room 205C

Stochastic Systems

Sponsor: Applied Probability

Sponsored Session

Chair: Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, mss@us.ibm.com

1 - Newsvendor with Risk Hedging — Order Quantity and Efficient Frontier

David Yao, Columbia University, Dept. of IEOR, New York, NY, United States of America, yao@columbia.edu, Liao Wang

We study a newsvendor model with the demand rate being a function of a market index (modelled as geometric Brownian motion), in addition to the usual Gaussian noise. We solve a Markowitz-type mean-variance problem with a hedging strategy, in addition to the one-time order-quantity decision; and discuss the related notions of efficient frontier.

2 - A Large-scale Service System with Packing Constraints

Sasha Stolyar, Bell Labs, Alcatel-Lucent, 600 Mountain Avenue, Murray Hill, NJ, United States of America, stolyar@research.bell-labs.com, Yuan Zhong

We consider a model motivated primarily by the problem of an efficient assignment of virtual machines to physical hosts in a network cloud to minimize the number of occupied hosts. There are multiple input flows of different customer types and infinite number of servers. Each server may simultaneously serve multiple customers, subject to general "packing constraints". We show that certain versions of greedy packing are asymptotically optimal as the input flow rates grow to infinity.

3 - Mean-field Limits for Some Load-balancing Algorithms

Kavita Ramanan, Professor of Applied Mathematics, Brown University, Box F, 182 George Street, Providence, RI, 02912, United States of America, kavita_ramanan@brown.edu, Arnab Ganguly

We establish mean-field limits for some load-balancing algorithms, and describe the scheduling insights obtained from these limits. Load-balancing algorithms of a similar flavour have mostly been studied under the assumption of exponential service distributions with the exception of recent work that uses the so-called cavity method. We introduce a new method, which might be of independent interest, that allows us to consider general service distributions.

4 - On a Class of Random Walks in the Quarter Plane
Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, mss@us.ibm.com, Tomasz Nowicki, Grzegorz Swirszcz

We consider a general class of random walks in the quarter plane and derive some fundamental properties of the stationary distribution for this class of random walks.

■ SD20

Level 2 - Room 205D

Markov Lecture

Sponsor: Applied Probability

Sponsored Session

Chair: Martin Reiman, Alcatel-Lucent Bell Labs, 600 Mountain Ave., Murray Hill, NJ, 07974, United States of America, marty@research.bell-labs.com

1 - A Stochastic Programming Based Approach to Assemble-to-order Inventory Systems
Martin Reiman, Alcatel-Lucent Bell Labs, 600 Mountain Ave., Murray Hill, NJ, 07974, United States of America, marty@research.bell-labs.com

The assemble-to-order system is a classical model in inventory theory. The optimal control for this system is known only for some very special cases. I will describe an approach to this problem based on a stochastic program (SP) that provides a lower bound on achievable cost. I will then describe how to translate the solution of this SP into a control policy, and present a proof of asymptotic optimality of this control policy. (Based on joint work with Mustafa Dogru and Qiong Wang)

■ SD21

Level 2 - Room 206

Contemporary Issues in Health Care Performance

Sponsor: Health Applications

Sponsored Session

Chair: Yasar A. Ozcan, Professor, Virginia Commonwealth University, PO Box 980203, Richmond, VA, 23298-0203, United States of America, ozcan@vcu.edu

1 - A Directional Distance Function Approach to Identifying the Input/Output Status of Medical Residents
Michael Vardanyan, I. SEG School of Management, Socle de la Grande Arche, 1, Parvis de la Défense, Paris La Défense, 92044, France, M.vardanyan@ieseg.fr, Vivian Valdmanis, Gary Ferrier, Hervé Leleu

The application of the human capital theory, the production theory, and the comparison of costs between teaching and non-teaching hospitals all point to the difficulties in identifying whether medical residents should be considered as inputs or outputs. We add to the debate by using a data-driven parametric approach based on the directional distance function to determine the status of residents. American Hospital Association data from 1994 to 2008 is used in the empirical illustration.

2 - The Impact of Private Rooms on Hospital-Acquired Infection: A Longitudinal Study
Liam O'Neil, Associate Professor, University of North Texas, Health Sciences Center, 3500 Camp Bowie Blvd, Fort Worth, TX, 76107, United States of America, liam.oneill@unthsc.edu, Vikram Tiwari, Anita Tucker

Data were obtained for 1.2 million patients undergoing 11 representative surgical procedures during 2004 - 2010. Adjusted rates of hospital-acquired infections were compared for 400+ hospitals with a high vs. low percentage of private rooms. Hospitals with mostly private rooms had significantly lower rates of hospital-acquired infections. The business case is examined for hospital renovations that include potential savings from reducing medical errors and improving patient satisfaction.

3 - An Examination of Competition and Efficiency for Hospital Industry
Yasar A. Ozcan, Professor, Virginia Commonwealth University, PO Box 980203, Richmond, VA, 23298-0203, United States of America, ozcan@vcu.edu, Ismet Sahin, Menderes Tarcan, Mustafa Narci, Hacer ÷zgen Narci

Technical efficiency of hospitals was estimated using Data Envelopment Analysis using five outputs and five inputs. The intensity of competition among hospitals was measured by objective and subjective measures. The relationship between competition and efficiency was examined by controlling the effects of demand and supply characteristics of the market and hospital traits. Tobit results showed competition did not have a significant relationship with hospital technical efficiency.

■ SD22

Level 2 - Room 207

Model-Based Analysis for Healthcare Decision Making

Cluster: Healthcare Systems/Informatics

Invited Session

Chair: Eva Enns, University of Minnesota, 420 Delaware Street SE, Mmc 729, Minneapolis, MN, 55455, United States of America, eenns@umn.edu

1 - Link Removal for Stochastic Epidemic Control over Networks
Eva Enns, University of Minnesota, 420 Delaware Street SE, Mmc 729, Minneapolis, MN, 55455, United States of America, eenns@umn.edu, Margaret Brandeau

The control of infectious diseases spread through close contact often focuses on interrupting the contact network. We previously developed an optimal quarantining algorithm that disconnects the maximum number of susceptible nodes from infected ones given a constraint on the number of links that can be removed. We compare the performance of this and other link removal schemes in reducing the likelihood of an epidemic in a stochastic model of disease transmission through a fixed contact network.

2 - Cautious Learning in Medical Decision Making
Diana Negoescu, Stanford University, negoescu@stanford.edu, Kostas Bimpikis, Margaret Brandeau, Dan Iancu

Accurate biomarkers to routinely assess the effectiveness of treatments for chronic illnesses are not always available. Medical decision makers must learn about treatment effectiveness using noisy, subjective feedback from patients. We develop a model for choosing between treatments with unknown stochastic effectiveness, where the belief about effectiveness evolves dynamically and treatments may have side effects that decrease quality of life. We illustrate our model for Multiple Sclerosis.

3 - Choice of Best-fitting Inputs in Mutli-target Model Calibration: Implications for Economic Analysis
Lauren Cipriano, Assistant Professor, Western University, Ivey Business School, London, ON, Canada, lcipriano@ivey.uwo.ca, Eva Enns, C. Torrey Simons, Chung Yin Kong

We describe a new approach for selecting best-fitting sets from a multi-target model calibration effort which applies the principles of Pareto-optimality. We demonstrate the new approach using a simple model, developed for illustrative purposes, and a previously-published model used for a cost-effectiveness analysis of transcatheter aortic valve replacement (TAVR). We explore the implications of how best-fitting sets are selected on which policy is preferred and decision uncertainty.

4 - Using Mathematical Modeling to Investigate Marginal Cost-effectiveness of Childhood Vaccinations
Michael Harvey, PhD Student, University of Michigan, 1415 Washington Heights, Ann Arbor, Mi, 48109-2029, United States of America, harveymj@umich.edu, David Hutton, Lisa Prosser

The number of ACIP recommended childhood immunizations has increased in the last decade. This increase is associated with change in coverage levels for some immunizations. Given this, there is interest in determining how coverage changes impact cost-effectiveness of vaccination. A theoretical SIR model was created and applied to recommended vaccines to investigate marginal coverage changes and the corresponding changes in effectiveness and cost-effectiveness in order to optimize coverage levels.

■ SD23

Level 2 - Room 208A

Pricing and Revenue Management in Pharmaceutical and Healthcare Industry

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Mehmet Sekip Altug, Assistant Professor, George Washington University, 2201 G Street, NW, 415 Floor, Washington, DC, 20052, United States of America, maltug@email.gwu.edu

1 - Investigating why Brand Drugs do not Lower their Price in the Face of Generic Competition

Kathleen Iacocca, University of Scranton, 439 Brennan Hall, University of Scranton, Scranton, PA, 18510, United States of America, kathleen.iacocca@scranton.edu, Yao Zhao, James Sawhill

This paper investigates why brand-name drugs are priced higher than their generic equivalents. We hypothesize that some consumers have a preference for brand names which outweighs the cost savings realized by switching to generics. We develop a structural demand model and proceed to estimate it using wholesale price and demand data. Applying the model to the pharmaceutical industry, we generate managerial insights by showing how changes in prices impact market share.

2 - Pharmaceutical Supply Chain Networks with Outsourcing under Price and Quality Competition

Dong Li, Doctoral Student, University of Massachusetts Amherst, 121 Presidents Drive, Amherst, MA, 01003, United States of America, dongl@som.umass.edu, Anna Nagurney, Ladimer Nagurney

We present a pharmaceutical supply chain network model with outsourcing under price and quality competition in equilibrium and dynamic versions. This model allows for the determination of the optimal product flows of in-house and outsourcing activities and provides the firm the optimal make-or-buy and contractor selection decisions. We state the variational inequality formulation and the dynamic adjustment processes of the model, and present several numerical examples with sensitivity analysis.

3 - Coordinating Product Launch Decisions in Pharmaceutical Industry

Mehmet Sekip Altug, Assistant Professor, George Washington University, 2201 G Street, NW, 415 Floor, Washington, DC, 20052, United States of America, maltug@email.gwu.edu, Ozge Sahin

We consider a pharmaceutical manufacturer that is planning the timing of a pioneer drug launch in a foreign country which will result in parallel import activity. We find out that the Generalized Nash-Bargaining problem leads to a unique equilibrium price and characterize the optimal launch time in closed form. The manufacturer may find it optimal to launch the product "immediately", delay it or not introduce it at all. We then study the price competition between the firm and local generics.

■ SD24

Level 2 - Room 208B

Pricing in the Presence of Multiple Customer Types

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Goker Aydin, Indiana University, 1309 East Tenth Street, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

1 - Product Upsell through Conditional Upgrades with Strategic Consumers

Yao Cui, University of Michigan, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, cuiyao@umich.edu, Ozge Sahin, Izak Duenyas

We study the conditional upgrade strategy that is recently used by firms in travel industry. After the original booking, the firm offers an upgrade so that the consumer can pay a fee to upgrade the product to a high-quality one if there are leftovers at the end of the booking period. Consumers anticipate the upgrade probability when making booking decisions. We characterize the firm's optimal upgrade price and discuss when and why the conditional upgrade strategy is beneficial to the firm.

2 - Contingent Pricing in the Presence of Loss Averse Consumers with Stochastic Reference Level

Sami Najafi-Asadolahi, University of Toronto, Toronto, ON, Canada, sami.najafi@rotman.utoronto.ca, Opher Baron, Ming Hu

We study an infinite period setting where a profit-maximizing firm sells a single perishable product at each period to two types of consumers: regular consumers, who have a given valuation and whose market size is uncertain; and bargain hunters, who have a low valuation and are abundant. The regular consumers are loss averse with random reference levels that represent their stochastic beliefs about the price and purchase outcome. We show that the firm can benefit from consumers' loss aversion.

3 - Revenue and Customer Relationship Management

Javad Nasiry, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, nasiry@ust.hk, Pascal Courty

We propose a model to study when guaranteed availability and fixed price policies are optimal under certain behavioral assumptions.

4 - Dynamic Pricing and Mail-in-Rebate Design with Limited Inventory

Shanshan Hu, Assistant Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, hush@indiana.edu

Mail-in-rebate and direct discount (i.e., instant rebate) are both used by retailers. However, their actual costs might be different in that, among the customers with mail-in-rebates, a sizable portion will fail to redeem them. The question arises: for a retailer with pressure to move inventory, how to use these tools, individually or concurrently? Our paper characterizes the optimal dynamic pricing and rebate offering policy, and establishes interesting insights into the above question.

■ SD25

Level 2 - Room 208C

Sponsored Search Auctions

Cluster: Auctions

Invited Session

Chair: Ian Kash, Microsoft Research Cambridge, 21 Station Road, Cambridge, CB1 2FB, United Kingdom, iankash@microsoft.com

1 - Probabilistic Broad Match for Multi-keyword Sponsored Search Auctions

Tie-Yan Liu, Senior Researcher, Microsoft Research Asia, No. 5, Danling Street, Haidian District, Beijing, China, tyliu@microsoft.com, Wei Chen, Di He, Liwei Wang

We propose a Probabilistic Broad Match mechanism for sponsored search auctions. Different from the existing mechanism that runs auction for ads bidding on all the keywords matched to a query, the new mechanism only runs auction for the ads bidding on a randomly sampled keyword each time. We prove the new mechanism to have better properties in terms of the existence of pure Nash equilibrium, a better POA bound for social welfare, and a better guarantee of search engine revenue in equilibrium.

2 - Truthful Ad Throttling

De Liu, University of Kentucky, 425D Gatton B&E Building, Lexington, KY, 40506, United States of America, de.liu@uky.edu

In ad auction prices, ad buyers are usually permitted to participate in a percentage of all auctions they are eligible for so that their spend may not exceed their budget. This practice, known as throttling, are often "optimized" without considering its impact on budget setting. We propose a throttle mechanism that is both truthful and efficient provided that ad buyer preferences can be modeled by a utility function. This mechanism combines a throttling schedule and a VCG-based ad auction.

3 - Ranking and Tradeoffs in Sponsored Search Auctions

Ian Kash, Microsoft Research Cambridge, 21 Station Road, Cambridge, CB1 2FB, United Kingdom, iankash@microsoft.com, Ben Roberts, Dinan Gunawardena, Peter Key

In a sponsored search auction, decisions about ranking ads impose tradeoffs between objectives. We argue that the natural solution concept to evaluate these tradeoffs is the lowest SNE by generalizing the connection between the lowest SNE and the VCG outcome. We then propose a new ranking algorithm that uses a reserve price to order the ads (not just to filter them). Finally, we examine the tradeoffs through simulations and show that our algorithm enables superior operating points.

■ SD26

Level 2 - Room 208D

Facility Location and Supply Chain Network Design

Sponsor: Location Analysis

Sponsored Session

Chair: Mengshi Lu, PhD Student, University of California at Berkeley, Department of IEOR, Berkeley, CA, 94720, United States of America, lvmengshi@gmail.com

1 - Reliable Location-routing Problem with Probabilistic Disruption
Weijun Xie, University of Illinois, Urbana, IL, United States of America, wxie4@illinois.edu, Yanfeng Ouyang

This paper presents a set covering based model for the reliable location routing problem with the existence of facility disruption risks. A variety of solution techniques (i.e., Lagrangian relaxation, Greedy, Interchange) is developed and analyzed. We also propose an alternative formulation including a continuum approximation model for this problem. Numerical study is conducted to test the performance of the proposed algorithms and draw managerial insights.

2 - Acquisition Viability When Combining Supply Chain Networks
Mariah Magagnotti, Clemson University, 717 Alpine Drive, Seneca, SC, 29672, United States of America, mariahm@clemson.edu, Scott Mason

During any corporate merger or acquisition, the need to combine each party's supply chain networks can be a complicated task. We present a multi-commodity, mixed-integer model that balances the costs of both network design and network flow decisions against the benefits of increased network connectivity to aid in decision making. Early results demonstrate the efficacy of our proposed solution approach.

3 - Robust Design of Hub-and-Spoke Network with Congestions
Yu An, University of South Florida, 4202 E Fowler Ave., ENB 118, Tampa, FL, 33620, United States of America, yan2@mail.usf.edu, Yu Zhang, Bo Zeng

We propose a hub-and-spoke system design scheme that simultaneously includes the practical factors of hub congestion and hub disruptions on the basis of the classical design model. Specifically, robust optimization technique is applied to handle the random hub failures. Demand loss factor will also be introduced to model the affected flows that can not be served in a failure scenario.

4 - Reliable Facility Location Design under Uncertain Correlated Disruptions
Mengshi Lu, PhD Student, University of California at Berkeley, Department of IEOR, Berkeley, CA, 94720, United States of America, lvmengshi@gmail.com, Z. Max Shen

We present a reliable facility location model that allows disruptions to be correlated with an uncertain joint distribution, and minimizes the expected cost under the worst-case distribution. We believe this robust optimization model could serve as an alternative approach for solving reliable facility location problems. Compared to the traditional approach, it better captures disruption propagation effect, requires much less computational effort, and delivers more favorable designs.

■ SD27

Level 2 - Room 209A

Things We Need: Tailoring Non-DoD Emergent Concepts, Innovation, and Technologies

Sponsor: Military Applications

Sponsored Session

Chair: Aaron D Burciaga, Senior Scientist, Elder Research, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, burciaga@dataminginglab.com

1 - The Evolution of Software for Supply Chain Planning: A Look Forward and a Look Back
Lora Cecere, founder, Supply Chain Insights, P 64 801 Key Highway, Baltimore, MD, 21230, United States of America, lora.cecere@supplychaininsights.com

Supply chain managment as a practice is thirty years old. Optimization and artifical intelligence technologies have evolved and matured to solve supply chain problems. But, were are we in driving supply chain progress? What is the road ahead? In this presentation, learn the current and future state from the author of the book, Bricks Matter.

2 - Fifth Generation Methods for Forecasting Spare Parts
Thomas Willemain, Senior Vice President, Smart Software, Inc., 4 Hill Road, Belmont, MA, 02478, United States of America, TomW@smartcorp.com

Management of spare parts inventories is complicated by the intermittent nature of demand. All four prior generations of intermittent demand forecasting methods processed each part in isolation. Gen5 methods discover and exploit demand correlations across parts. These correlations define the "social network of parts". Besides providing a new way to forecast demand, this collective approach will also be useful in non-forecasting tasks by giving a big picture view of an entire fleet of parts.

■ SD28

Level 2 - Room 209B

Algorithms and Applications

Cluster: Data Envelopment Analysis

Invited Session

Chair: Andrew Johnson, Texas A & M University, College Station, TX, United States of America, ajohnson@tamu.edu

1 - European Competitiveness: A Nonparametric Stochastic Firm-level TFP Analysis
Marijn Verschelde, Postdoc, Ghent University Department of General Economics, Tweekerkenstraat 2, Ghent, 9000, Belgium, Marijn.Verschelde@UGent.be, Bruno Merlevede, Glenn Rayp, Michel Dumont

This paper analyses TFP at firm-level to obtain insights that are of use for the recent competitiveness debate in Europe. Noise is non-negligible in any large scale firm-level dataset, making the use of deterministic frontier based approaches not advisable. We advocate a nonparametric stochastic frontier based alternative. We decompose and analyze a nonparametric stochastic TFP index using AMADEUS firm-level data of more than 1 million firms covering 20 manufacturing sectors in the EU-15.

2 - Internal Benchmarking of the Divisions of the Wyoming Highway Patrol using DEA
Mehmet E. Ozbek, Assistant Professor, Colorado State University, Guggenheim Hall Campus Delivery 1584, Fort Collins, CO, 80523, United States of America, mehmet.ozbek@colostate.edu, Maral Jalili

Wyoming Highway Patrol (WHP) is a data-driven organization which uses multiple measures that are outlined in its Balanced Scorecard to assess performance. WHP consists of 18 divisions which undertake the patrol operations under different external conditions such as traffic volumes, climate, etc. This presentation discusses a DEA-based performance assessment system that will enable WHP to identify its best-performing (i.e., most efficient) divisions to be able to use those as internal benchmarks.

3 - Algorithms for Streaming DEA
Jose Dula, Virginia Commonwealth University, Snead Hall, Richmond, VA, United States of America, jdula@vcu.edu, Francisco Lopez

A real challenge for DEA arises when data stream in at high rates. Potential applications involving large data sets include auditing, appraisals, fraud detection, and security. We introduce algorithms to process streaming data in the VRS case efficiently. Results from computational tests are discussed.

■ SD29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Artelys – Optimizing Military Attacks on Multi-commodity SC Networks: Min-max Problem Solved with Artelys Kalis,
Sylvain Mouret, Artelys, 12 rue du Quatre Septembre, Paris, 75002, France, sylvain.mouret@artelys.com

Learn how easy it is to solve general min-max problems arising in adversarial games with Artelys Kalis. Thanks to its hybrid CP/MIP architecture, it is possible to build an efficient branch and bound method specialized for such problems in just a few lines of code. We will demonstrate how Kalis has been embedded in a full-range operational solution based on the Artelys Network Designer GIS visualization platform. This solution is currently used to study supply chain network vulnerabilities with respect to military attacks.

2 - MathWorks – MATLAB: An Environment for Operations Research and Data Analytics

Seth DeLand, Product Manager, Optimization Products, MathWorks, 3 Apple Hill Dr., Natick, MA, 01760, United States of America, seth.deland@mathworks.com

MATLAB is a platform for analysis, visualization, simulation and optimization. You can access and analyze real-world data and develop customized algorithms that help make better decisions. Join us to see what's new and how MATLAB can help you explore data, develop algorithms, and integrate programs into enterprise applications.

■ SD30

Level 2 - Room 210B

Individual Differences in Operations

Cluster: Workforce Engineering and Management

Invited Session

Chair: Kenneth Doerr, Associate Professor, Naval Postgraduate School, 555 Dyer Road, Monterey, CA, 93943, United States of America, khdoerr@nps.edu

1 - Centralization vs Decentralization and Referral Rate: A Behavioral Perspective

Rosa Hendijani, PhD Candidate, University of Calgary, 2500 University Drive NW, Calgary, AB, T2N 1N4, Canada, rosa.hendijani@gmail.com, Diane Bischak

This study examines centralization versus decentralization from a behavioral perspective. We designed an experiment to examine how a shift from a decentralized referral system, characterized by a close relationship between general practitioners and specialists, to a centralized referral system would affect referral rate. The results indicated that high confidence doctors referred significantly fewer patients in a close-relationship condition in comparison with the centralized referral system.

2 - Cognition and Heterogeneity in Multi-Echelon Supply Chains

Brent Moritz, Assistant Professor, Pennsylvania State University, 469 Business Building, University Park, PA, 16802, United States of America, bmoritz@psu.edu, Chalam Narayanan

Supply chain performance often depends on the decisions of individual channel members. Using a supply chain simulation, we find that the cogntive profile of the decision maker impacts performance, and this results holds under standard mitigation strategies. The findings have implications for supply chain and design of decision support structures.

3 - Creating and Resolving Flux in Team Action Processes

David Cantor, Assistant Professor, Iowa State University, 2340 Gerdin Business Bldg, Ames, IA, 50011, United States of America, dcantor@iastate.edu, James Summers

Supply chains have seen an increase in team-based work structures. We investigate how cross-functional supply chain teams manage responses to stretch work in a SAP simulation game. Using a sample 300 undergraduate students (100 3-person teams), we examine how team structure and individual differences impact team processes and performance in the hyper-competitive SAP simulation environment. Preliminary results and findings will be discussed.

4 - Deadline Rush and Task Sharing

Kenneth Doerr, Associate Professor, Naval Postgraduate School, 555 Dyer Road, Monterey, CA, 93943, United States of America, khdoerr@nps.edu, David Nembhard

Deadline rush is the change in work rate entailed by the presence of a deadline. Task sharing is the delegation of a task to varying (adjacent) workers according to a workflow policy. We investigate the impact deadline rush has on task sharing in two kinds of operating systems (quota-based, and asynchronous-paced). We find that individual differences in deadline reactivity has an impact on the efficacy of task sharing, with a stronger impact in quota-based systems.

■ SD31

Level 2 - Room 211A

Financial Modeling and Computation

Sponsor: Financial Services

Sponsored Session

Chair: Lingfei Li, Assistant Professor, The Chinese University of Hong Kong, 608 MMW Engineering Building, Shatin, N.T., Hong Kong - PRC, lfli@se.cuhk.edu.hk

1 - Ross Recovery in Markovian Economies I

Vadim Linetsky, Professor, Northwestern University, 2145 Sheridan Rd., Evanston, IL, 60202, United States of America, linetsky@iems.northwestern.edu, Likuan Qin

This talk will survey our work on extending the Ross recovery theorem to general Markovian economies.

2 - Ross Recovery in Markovian Economies II

Likuan Qin, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, LikuanQin2012@u.northwestern.edu, Vadim Linetsky

This talk will survey our work on extending the Ross recovery theorem to general Markovian economies.

3 - Multi-curve Modeling with Multi-factor Short Rate Models

Qi Wu, Assistant Professor, Chinese University of Hong Kong, 507, William M.W. Mong Eng. Building, Shatin, NT, Hong Kong - PRC, qwu@se.cuhk.edu.hk

The burst of US housing bubble and the on-going European sovereign debt crisis have fundamentally changed the way global fixed income markets operate, so has been the modeling of interest rates. In this talk, we discuss the joint curve modeling in short rate framework with multi-factor Gaussian processes and provide accurate analytical approximations of swaption normal vol and caplet vol.

4 - Optimal Multiple Stopping and Switching: An Eigenfunction Expansion Approach

Lingfei Li, Assistant Professor, The Chinese University of Hong Kong, 608 MMW Engineering Building, Shatin, N.T., Hong Kong - PRC, lfli@se.cuhk.edu.hk

We develop an eigenfunction expansion based approach to solve finite horizon discrete time optimal multiple stopping and switching problems for a rich class of Markov processes. To illustrate the method we consider two applications: pricing chooser flexible cap (floor) under popular short rate models and valuation of combination cargo carriers in the shipping industry.

■ SD32

Level 2 - Room 211B

Joint Session TMS/NPD: Meet the Editors

Sponsor: Technology Management & New Product Development,

Sponsored Session

Chair: Sinan Erzurumlu, Babson College, 231 Forest St., Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

Co-Chair: Karthik Ramachandran, Assistant Professor, Georgia Institute of Technology, Scheller College of Business, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu

Co-Chair: Jeremy Hutchison-Krupat, Assistant Professor, Darden School of Business, University of Virginia, 100 Daredn Blvd, Charlottesville, VA, 22903, United States of America, krupatj@darden.virginia.edu

1 - Panel Discussion: Meet the Editors

Moderator: Sinan Erzurumlu, Babson College, 231 Forest St., Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu, Panelists: Jeremy Hutchison-Krupat, Karthik Ramachandran

This interactive session aims at assisting readers and researchers in staying informed on the most important topics and the latest development in Technology, Innovation Management, Entrepreneurship and New Product Development.

■ SD33

Level 2 - Room 211C

Passenger Railway Timetabling and Planning (RAS Roundtable Part 2)

Sponsor: Railway Applications

Sponsored Session

Chair: Carl VanDyke, Partner, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, Carl.VanDyke@oliverwyman.com

1 - Passenger Timetabling/Planning Tools Framework

Carl VanDyke, Partner, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, Carl.VanDyke@oliverwyman.com

Passenger timetabling must take into account many issues including the scheduling of trains, allocation of carrying capacity against customer demand, make-up of the trains given the equipment fleet, assignment of crews, scheduling of "recovery" trains, allocation of "slots" over the rail lines, planning of platform occupancy, utilization of yards, consumption of fuel & electricity, etc. A structured framework for the timetabling process will be presented, and existing tools identified.

2 - Simulating the Effects of PTC Systems on Railroad Operations

Ian Martin, Director - Operations Analysis, SYSTRA, 520 Eighth Avenue, Suite 2100, New York, NY, 10018, United States of America, imartin@systra.com, Ted Jones

This presentation will discuss the simulation of train operations under a system with and without positive train control (PTC). This paper will focus on the ACSES PTC overlay system being deployed on the Northeast Corridor (NEC) by Amtrak and the various commuter railroads operating in the Northeast on and adjacent to the NEC.

3 - Schedule Planning using an Interactive Analysis Approach

Edwin R "Chip" Kraft, TEMS, Inc., 116 Record Street, Frederick, MD, 21701, United States of America, ckraft@temsinc.com

The Interactive Analysis is a strategic assessment whereby the service and equipment attributes for each scenario and the interaction between infrastructure, demand and operations are appraised simultaneously. The result optimizes the financial and economic returns associated with a project and balances equipment technology, capital, operating cost and ridership. This presentation will describe how demand, operations and trains schedules are linked in the capacity planning process.

4 - Crew and Equipment Optimization for Passenger Rail

Marc Meketon, Vice President, Oliver Wyman, 100 University Square, Suite 100, Princeton, NJ, 08540, United States of America, marc.meketon@oliverwyman.com

Specific approaches work well for equipment and crew planning and optimization for passenger rail that can reduce total labor costs and equipment needs - or increase the total number of trains that can be operated with the same number of trains. A set of specific techniques that have been applied at actual passenger operators will be presented.

■ SD34

Level 2 - Room 211D

Optimization via Simulation

Sponsor: Simulation Society

Sponsored Session

Chair: Sigrun Andradottir, Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, sa@isye.gatech.edu

1 - Ranking and Selection with Tight Bounds on Probability of Correct Selection

Peter Frazier, Assistant Professor, Cornell University, School of ORIE, Rhodes Hall, Ithaca, NY, United States of America, pf98@cornell.edu

Existing procedures for indifference-zone (IZ) ranking and selection have loose bounds on probability of correct selection, leading them to sample more than necessary. We present BIZ, the first sequential elimination IZ procedure with tight bounds on worst-case preference-zone probability of correct selection. Tight bounds allow the procedure to produce solutions with less sampling effort. In this talk, we extend previous results to the case with unknown and heterogeneous sampling variance.

2 - Ghost Model in Simulation Based Optimization

Felisa Vazquez Abad, Professor, Hunter College, 695 Park Ave., New York, NY, 10021, United States of America, felisav@hunter.cuny.edu

We present a simulation model for large two-time scale networks that increases the efficiency compared to a discrete event simulation model. Faster point processes are replaced by a "fluid" (ghost process) to accelerate the execution time. When a local clock advances due to a slower event, retrospective calculations (Filtered Monte Carlo) recover the fine detail lost in the fluid model. Efficiency improvement results not only from the speed of execution, but also from variance reduction.

3 - Evaluating the Impact of Targets with Correlated Attributes on Ranking and Selection

Douglas Morrice, Professor, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, douglas.morrice@mccombs.utexas.edu, John Butler, Jason Merrick

Using constraints in multiattribute ranking and selection (R&S) is gaining popularity. Intuitively, a constraint will increase the variance of attribute score(s) and reduce the effectiveness of an R&S procedure. Further, the increase in variance will be largest when a constraint is close to an attribute mean. We derive the impact on R&S procedures when there are two correlated normally distributed performance measures for a variety of utility functions that capture the notion of a constraint.

4 - Pareto Set Estimation using Ranking and Selection

Judy Lee, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, jlee@isye.gatech.edu, Sigrun Andradottir

We consider the ranking and selection problem with multiple objectives and present an algorithm to estimate a Pareto set. We provide three different formulations, i.e., retaining all the desirable and eliminating all the undesirable systems, or achieving either one of the two aforementioned goals. In each case, we identify appropriate choices of parameter values and prove that the resulting algorithm guarantees the desired probability of correct selection.

■ SD35

Level 2 - Room 212A

Economics of Information Systems

Sponsor: E-Business

Sponsored Session

Chair: Lin Hao, University of Notre Dame, Mendoza College of Business, Notre Dame, United States of America, lhao@nd.edu

1 - An Empirical Analysis of the Survivability of New Sellers in an Online Marketplace

Xue Tan, University of Washington at Seattle, Mackenzie 350, Seattle, WA, 98195, United States of America, xuetan@uw.edu, Yong Tan, Ming Fan

In this work, we empirically investigate the survivability of new sellers in a large online marketplace. Using a dataset of 13264 new sellers in a time span of 11 months, we formulate a survival model to estimate the effects of a series of traffic characteristics. We examine the interactive relationship among these traffic characteristics, and validate their time variant effects.

2 - Integration and Bilateral Sabotage

Hong Guo, Assistant Professor, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo@nd.edu, Yabing Jiang, Asoo Vakharia

We study integration of firms in two interrelated markets that are two-way essential complements. A unique phenomenon arises in this setting as the integrated firm may engage in bilateral sabotage. This paper analyzes the integrated firm's incentives for sabotage and its impact on social welfare. Our findings provide important managerial and policy implications for integration of two-way essential complements, such as recent acquisitions and mergers in the technology sector.

3 - Opinion Formation in Social Media Platform

Yingda Lu, Assistant Professor, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, 12180, United States of America, luy6@rpi.edu, Yong Tan, Junjie Wu

In this paper, we collect an innovative dataset on user posting microblogs from a social media website. Using natural experiment method, we demonstrate how individual decision of retweeting a microblog is influenced by the posts from the public as well as those from their friends. Furthermore, we also illustrate how public opinions and peer opinions have different impact on the formation of individual opinions on a social media platform.

4 - Which Physicians Are More Likely To Be Reviewed Online By Patients?

Haijing Hao, Assistant Professor, University of Massachusetts Boston, Boston, MA, United States of America, haijing.hao@umb.edu

This study empirically examines what factors are associated with physicians' online evaluation based on a unique dataset from one of the largest patients-physician online community in China. The preliminary result shows that the more physicians interact with their patients online, the more likely that they will receive a higher evaluation score.

■ SD36

Level 2 - Room 212B

Models for Emergency Medical Services

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Laura McLay, Associate Professor, University of Wisconsin-Madison, Industrial & Systems Engineering, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - Scalable Approach to Joint Location and Dispatching Decisions for Emergency Medical Service Systems

Maria Mayorga, Clemson University, Raleigh, NC, United States of America, mayorga@clemson.edu, Hector Toro-Diaz, Laura McLay

Emergency Medical Service (EMS) systems provide medical care to emergency patients. Jointly optimizing location and dispatching decisions can improve equitability measures in EMS systems. However, existing methods are not scalable. We incorporate linear approximations to the hypercube model and allow for multiple vehicles at a station. We developed a hybrid method which uses tabu-search with a non-deterministic tabu-list. The model is tested on two real world data sets.

2 - Modeling Red and Yellow Alert Durations for Ambulance Systems as Partial Busy Periods

Amir Rastpour, School of Business, University of Alberta, Edmonton AB T6G2R6, Canada, rastpour@ualberta.ca, Armann Ingolfsson, Bora Kolfal

Ambulance red and yellow alerts are time periods during which all or most ambulances are busy. Modeling such systems as Erlang loss systems, we obtain first moments of alert period duration, showing them to be independent of the shape of the service time distribution. We study the impact of increasing the number or service speed of ambulances. We show that our results are consistent with empirical data from Calgary. We obtain alert duration Laplace Transforms for GH-distributed service times.

3 - A Markov Decision Process Model for Ambulance Allocation

Kenneth Chong, Ph.D. Candidate, Cornell University, ORIE, Ithaca, NY, 14853, United States of America, kcc66@cornell.edu, Shane Henderson, Mark Lewis

We consider a queueing model of an Emergency Medical Service (EMS) system that operates two types of ambulancesó"advanced" and "basic"ó and serves two emergency call priority levels. Ambulances can be assigned to calls of either priority level, but undesirable allocations are penalized. We formulate this problem as a Markov Decision Process (MDP); its value function is, in general, neither concave nor submodular. We characterize, under certain conditions, the structure of the optimal policy.

4 - Allocation Models for Shared Ambulance Services

Lavanya Marla, Assistant Professor, University of Illinois at Urbana-Champaign, 104 S. Mathews Avenue, 216E, Urbana, IL, 61801, United States of America, lavanyam@illinois.edu

We consider the setting where multiple ambulance services compete to serve a population. Specifically, the instance considered is where 911-type services are currently being set up, and they compete with existing ad-hoc services. We present modeling frameworks that allow for better ambulance utilization (to decrease ambulance abandonment) and improve service levels for the population.

■ SD37

Level 2 - Room 213A

Managing Uncertain Environments in Health Care

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Bjorn Berg, Assistant Professor, George Mason University, 4400 University Drive, MS 4A6, Fairfax, VA, 22030, United States of America, bberg2@gmu.edu

1 - Dynamic Scheduling of Same-day Requests in Primary Care Practices

Hari Balasubramanian, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, 01003, United States of America, hbalasubraman@ecs.umass.edu, Ana Muriel

Appointments in primary care are of two types: 1) prescheduled appointments, which are booked in advance of a given workday; and 2) same-day appointments, which are booked as calls come during the workday. The challenge for practices is to provide preferred time slots for prescheduled appointments and yet see as many same-day patients as possible during regular work hours. We formulate the problem as a stochastic dynamic program and develop guidelines for practices.

2 - Valuing Administrative Solutions to Handle Patient Volume Uncertainty in Nurse Staffing/Scheduling

Kibaek Kim, Northwestern University, Evanston, IL, United States of America, Kibaek.Kim@u.northwestern.edu, Sanjay Mehrotra

Uncertain patient volume fluctuation complicates nurse staffing and scheduling decisions. Moreover, limited budget for nursing positions compels hospital operations managers to efficiently utilize nursing staffs without lose of care quality. We present a decision support model to evaluate the benefit of flexing the nurse staffing levels for different care units and nurse float pool. We further analyze the cost implications of using part-time nurses and float pool nurses.

3 - Arranging Work Schedules for Service Access and Satisfaction

Linda Laganga, Director of Quality Systems & Operational Excellence, Mental Health Center of Denver, 4141 East Dickenson Place, Denver, CO, 80222, United States of America, linda.laganga@mhcd.org, Jim Linderman, CJ McKinney, Wes Williams, Craig Iverson

Our applied work started in July, 2012, as part of a national learning collaborative on same-day clinical appointment scheduling. We track and analyze our actual no-show and service duration data, and have used results to drive changes in scheduling and service delivery practices. We measure the effects and surveyed staff and consumers on their satisfaction with key changes. Results help inform other research by identifying scheduling factors that impact clinic performance.

4 - Admission Policies for Walk-in Patients at a Diagnostic Center

Nomesh Bolia, United States of America, nomesh@gmail.com, Vidyadhar Kulkarni

We consider a diagnostic center with scheduled and walk-in patients where the former may not show up with some probability. The center therefore admits some walk-ins and has to decide whether to admit a given walk-in patient. The only waiting cost is a terminal cost for patients not served by the end of the day. Using dynamic programming, we prove the optimality of a switching curve for the admission policy. We also develop a heuristic that is easier to implement and performs well.

■ SD38

Level 2 - Room 213B

Metaheuristics for Decision-making and Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Pekka Malo, Assistant Professor, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, Finland, pekka.malo@aalto.fi

1 - Evolutionary Approach to Bilevel Optimization: An Efficient Algorithm and Test-problems

Pekka Malo, Assistant Professor, Aalto University School of Business, Runeberginkatu 22-24, Helsinki, Finland, pekka.malo@aalto.fi, Ankur Sinha

Bilevel programming is a branch of optimization, which contains a nested optimization problem within the constraints of the outer optimization problem. In this paper, we discuss an evolutionary algorithm for solving general single-objective bilevel problems. We also present a procedure for designing controlled test problems with different types of commonly encountered difficulties. The obtained results can be used as a benchmark while evaluating alternative approaches.

2 - Multi-objective Stackelberg Problem: A Case Study in Environmental Economics

Ankur Sinha, PhD, Department of Information and Service Economy, Aalto University, Runeberginkatu 22-24, Helsinki, 00100, Finland, ankur.sinha@aalto.fi, Pekka Malo

We discuss a multi-objective Stackelberg model, where the leader is a regulating authority and the follower is a mining company. The leader tries to maximize its revenues and minimize the environmental damage caused by the mining company. The sole objective of the follower is to maximize its profit under the limitations set by the leader. We formulate the model and solve it using evolutionary algorithms to determine the optimal decisions over multiple periods for the leader and the follower.

3 - Determining Topic Sentiments Based on a Two-level Financial Sentiment Corpus

Oskar Ahlgren, Aalto University, Runeberginkatu 22-24, Helsinki, 00100, Finland, oskar.ahlgren@aalto.fi

Sentiment analysis is a highly domain specific. Therefore, to be able to utilize the recent advances in statistical natural language processing, a high-quality financial corpus is necessary. In this paper, we introduce specific sentiment models for both document and sentence levels, and apply them on a newly constructed human annotated financial news corpus.

4 - Extracting Sentiments from Financial Text

Bikesh Raj Upreti, Researcher, Aalto University School of Business, Pohjavedenkatu 4 B, 53, Helsinki, Finland, bikesh.upreti@aalto.fi

We present our on-going work on financial sentiment analysis. The proposed model is based on a combination of statistical natural language processing techniques with a novel machine-learning mechanism. The model is trained on a recently annotated financial dataset, which contains a large number of attributes for features commonly found in financial text. The model is compared with multiple baselines to study the performance gains obtained due to the newly introduced aspects.

■ SD39

Auditorium 3

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Intaver Institute Inc. - Intaver RiskyProject Software

Lev Virine, Chief of Innovation, Risk Management and Decision Analysis, Intaver Institute Inc., 303, 6707 Elbow Drive S.W., Calgary, Alberta, T2V0E5, Canada, lvirine@intaver.com

Intaver's RiskyProject is enterprise project risk management and risk analysis software. RiskyProject is used for project and portfolio planning, scheduling, qualitative risk analysis and quantitative analysis using Monte Carlo simulations. The presentation demonstrates RiskyProject software: how to identify and manage project risks, perform risk analysis using Monte Carlo, and interpret the results of analysis

2 - Oracle - Learn about Oracle Crystal Ball

Michael Franden, Applications Sales, Oracle, 1900 Oracle Way, Reston, VA, 20190, United States of America, michael.franden@oracle.com

Oracle's Crystal Ball software is a spreadsheet-based software suite for predictive modeling, forecasting, Monte Carlo simulation and optimization. Crystal Ball is used in universities, businesses, and governments worldwide to teach financial risk analysis, valuation, engineering, portfolio allocation, cost estimation, and project management. Join us for an overview of Crystal Ball, its uses and our teaching resources.

■ SD40

Auditorium 2

Auctions in Practice

Cluster: Auctions

Invited Session

Chair: Tunay Tunca, tunca01@gmail.com

1 - The Impact of Winner Information on the Competitive Bidding in B2B Sequential Dutch Auctions

Wolf Ketter, Associate Professor, Erasmus University, Rotterdam School of Management, Rotterdam, Netherlands, WKetter@rsm.nl, Eric van Heck, Alok Gupta, Yixin Lu

We conduct a field experiment to study how changes in the availability of winner information influence bidders' decisions and overall outcomes in a complex B2B market. We find that public signals related to winner ID have positive effects on tacit collusion. This suggests that auctioneers should not communicate winner ID to the bidders in the sequential auctions in order to deter future collusion.

2 - Empirical Analysis of Multi-attribute Procurement Auctions for the Public Healthcare Sector in Chile

Bernardo Quiroga, PhD Candidate, The Pennsylvania State University, Smeal College of Business, 454 Business Building, University Park, PA, 16802, United States of America, bquiroga@psualum.com

The Chilean Public Procurement Agency, ChileCompra, implements multi-attribute reverse auction mechanisms to purchase all governmental acquisitions in the country, producing a very interesting real-life experiment on multi-dimensional bidding. Using the analytical structure of the bidding game, and existing data from auctions conducted by ChileCompra on behalf of the Public Healthcare sector, we study the empirical effect on incentives and the procurement cost of this bidding mechanism.

3 - Electronic Reverse Auction Project Satisfaction: A Model and Empirical Test

Willem Standaert, Ghent University, Gent, 9000, Belgium, Willem.Standaert@UGent.be, Steve Muylle

We develop and empirically test a model that hypothesizes positive relationships between electronic reverse auction (ERA) project satisfaction and different project outcomes. We find that ERA project satisfaction is positively related to financial, operational, and relationship outcomes. Our model and field study also reveal that project team experience and procedural fairness contribute to realizing potentially conflicting price, quality, and relationship outcomes.

■ SD41

Level 1 -101A

Social Interactions and Operations Management II

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, M5S 3E6, Canada, Ming.Hu@Rotman.Utoronto.Ca

1 - The Value of Temporal Data for Learning Networks of Influence Faster

Spyros Zoumpoulis, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, United States of America, szoumpou@mit.edu, Munther Dahleh, John N. Tsitsiklis

We assess the value of temporal data for learning local influence relations between networked entities from data on outcomes both theoretically and practically. Our theoretical guarantees characterize the sufficient and necessary scaling of samples required for correct learning under different data modes. Experiments on both synthetic and real data quantify the improvement in learning due to richer temporal data, and show that our methodology recovers the underlying network well.

2 - Targeted Information Release in Social Networks

Ying-Ju Chen, University of California-Berkeley, Department of Industrial Engineering, Berkeley, CA, United States of America, chen@ieor.berkeley.edu, Junjie Zhou

Various firms initially make information and access to their products/services scarce within a social network; thus, identifying influential players that facilitate information dissemination emerges as a pivotal step for their success. Using a stylized model that features payoff externalities and local network effects, we show that the signaling incentive drives the optimal selection of leaders and can lead to a first-order materialistic effect on the equilibrium outcomes.

3 - Liking and Following and the Newsvendor: Operations and Marketing Policies under Social Influence

Jiahua Wu, Rotman School of Management, University of Toronto, 105 St. George Street, Toronto, ON, M5S 3E4, Canada, Jiahua.Wu09@Rotman.Utoronto.Ca, Ming Hu, Joseph Milner

We consider a monopolistic firm selling two substitutable products to a stream of sequential arrivals whose purchase decisions can be influenced by earlier purchases. Ex ante demand, the firm faces a newsvendor problem for the two products with economies of scale in production for each. Social influence among customers has mainly negative effect on the newsvendor. We propose two solutions for the firm to better cope with social influence: firm-recruited influencers and production postponement.

4 - Information Heterogeneity and the Speed of Learning in Social Networks

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, 418 Uris Hall, New York, NY, 10023, United States of America, alirezat@columbia.edu, Ali Jadbabaie, Pooya Molavi

This paper examines how the structure of a social network and the quality of information available to different agents determine the speed of social learning. We show that the rate of learning has a simple analytical characterization in terms of the relative entropy of agents' signal structures and their eigenvector centralities. Our characterization establishes that the way information is dispersed throughout the social network has non-trivial implications for the rate of learning.

■ SD42

Level 1 -101B

Supply Chain Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Alp Muharremoglu, Associate Professor, University of Texas at Dallas, 800 West Campbell Rd., Richardson, TX, United States of America, alp@utdallas.edu

1 - Inventory Optimization for Industrial-sized Assemble-to-Order Systems

Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu, Willem van Jaarsveld

We provide insights and algorithms for inventory control in industrial-sized Assemble-To-Order systems. We first focus on first-come first-serve (FCFS) allocation of components to products. Using a novel stochastic programming formulation, we compute solutions that are within one percent of the lower bound for realistically sized systems. We then answer the following questions: How do common heuristics used in practice compare to our performance, and how costly is the FCFS assumption?

2 - Fixed-Dimensional Stochastic Dynamic Programs: An Approximation Scheme and an Inventory Application

Wei Chen, University of Texas-Dallas, Richardson, TX, United States of America, wxc103020@utdallas.edu, Milind Dawande, Ganesh Janakiraman

We study fixed-dimensional stochastic dynamic programs in a discrete setting. Under the assumption that the cost-to-go functions are discrete L#-convex, we propose a pseudo-polynomial approximation scheme that solves this problem to within an arbitrary pre-specified additive error. The main technique we develop for obtaining our scheme is approximation of a fixed-dimensional L#-convex function on a bounded rectangular set, using only a selected number of points in its domain.

3 - Cost Reduction through Operations Reversal

Yue Zhang, PhD Student, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yueyue.zhang@duke.edu, Ki Ling Cheung, Jeannette Song

Previous research has established conditions under which operations reversal is beneficial in terms of minimizing total variability. We show that additional conditions are needed if the objective is to minimize the long-run average cost. These conditions imply that the features with less variable demands should always be processed first.

4 - Inducing Reliable Supply: Simple Versus Simplistic Contracts

Woonam Hwang, PhD Candidate, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, whwang.phd2009@london.edu, Nitin Bakshi, Victor DeMiguel

Disruption risk in supply can be mitigated through the supplier's effort, but it is often not contractible in a decentralized supply chain. We show that a sufficiently complex contract can coordinate the supply chain. However, complex contracts are often not practicable. Therefore, we investigate the trade-off between simplicity and efficiency of contracts. We find that efficiency hinges critically on the type of supply risk and the relative bargaining power of the parties involved.

■ SD43

Level 1 -101C

Supply Chain Risk Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Dimitris Kostamis, UNC Kenan-Flagler Business School, 4710 McColl Bldg, Chapel Hill, NC, 27599, United States of America, dimitris_kostamis@unc.edu

1 - Managing Supply Disruptions via Multiple Sourcing when Output Affects Market Price

Bin Hu, University of North Carolina-Chapel Hill, Kenan-Flagler Business School, McColl Building CB3490, Chapel Hill, NC, 27599, United States of America, Bin_Hu@unc.edu, Dimitris Kostamis

We study a manufacturer's sourcing strategies when some but not all suppliers face supply disruption risks, and the manufacturer's output affects market price. We find that 1) when the manufacturer orders from reliable and unreliable suppliers, unreliable orders are invariant of market size; 2) when ordering from one reliable and one unreliable supplier, the total order quantity and its allocation between the two are independent decisions. We then extend all results to an asymmetric oligopoly.

2 - Doing while Learning: Data Driven Production Strategies under Ambiguity

Soroush Saghafian, Arizona State University, 699 S. Mill Avenue, Tempe, AZ, 85281, United States of America, Soroush.Saghafian@asu.edu, Brian Tomlin

Demand and/or supply uncertainty is a key challenge in production planning. An crucial complication in many settings is that the firm does not even have full information about the distribution of demand or supply random variable (i.e., ambiguity). Managers therefore have to produce ("do") while learning about the random demand or supply. We present a new data-driven approach to production planning when there is ambiguity about the underlying distribution of a relevant random variable.

3 - Disruption Risk and Optimal Sourcing in Multitier Supply Chains

Erjie Ang, Stanford University, Graduate School of Business, Mail code 5015, Stanford, CA, 94305, United States of America, erjieang@stanford.edu, Robert Swinney, Dan Iancu

We analyze a supply chain in which a manufacturer sources critical components from Tier 1 suppliers, who in turn source components from a possibly overlapping set of Tier 2 suppliers prone to disruption. We consider how the manufacturer can optimally source and contract with Tier 1 suppliers given this effect, and discuss robust sourcing strategies that the manufacturer can employ if its does not know the structure and degree of supplier overlap of the upper levels of its supply network.

4 - Contracting for On-time Delivery in the U.S. Influenza Vaccine Supply Chain

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu, Fuqiang Zhang, Soo-Haeng Cho

Motivated by the contracts used in the influenza vaccine industry, we study a supply chain contracting problem under uncertainties in product design, delivery, and demand. In this supply chain, it is critical for a vaccine manufacturer to choose the right production quantity at the right time. We show that several well-known contracts fail to coordinate this supply chain. Thus we propose new coordinating contracts and compare their performance with the contracts used in the industry.

■ SD44

Level 1 -101D

Empirical Research in Supply Chains

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Vishal Gaur, Professor of Operations Management, Johnson School, Cornell University, 321 Sage Hall, Ithaca, NY, 14853, United States of America, vg77@cornell.edu

1 - Does Inventory Productivity Predict Future Stock Returns? A Retailing Industry Perspective

Yasin Alan, Assistant Professor of Operations Management, Vanderbilt University, Owen School, 401 21st Ave. S., Nashville, TN, 37203, United States of America, Yasin.Alan@owen.vanderbilt.edu, Vishal Gaur, George Gao

We find that inventory productivity strongly predicts future stock returns among a sample of U.S. retailers between 1985 to 2010. A zero-cost long-short portfolio investment strategy, which consists of buying from the two highest and selling from the two lowest quintiles formed on inventory turnover, earns more than 1% abnormal return per month on average. Our findings suggest that the stock market rewards retailers with high inventory productivity.

2 - Severe Weather and Automobile Assembly Productivity

Marcelo Olivares, Columbia Business School/ Universidad de Chile, Republica 701, Santiago, Chile, mo2338@columbia.edu, Gerard Cachon, Santiago Gallino

Using panel data on weekly production of US assembly plants over a period of 10 years, we estimate the impact of severe weather on the productivity of these plants. We find that severe weather can add substantial variability to the production of new vehicles. Using our estimates, we project the potential impact of climate change over the next decades.

3 - An Empirical Study of Inventory Showrooming in Online Retail

Antonio Moreno-Garcia, Northwestern University, Evanston, IL, United States of America, a-moreno@kellogg.northwestern.edu, Santiago Gallino

Using data from a leading online retailer of eyewear, we study the effect of opening brick and mortar showrooms to display inventory that can be ordered online.

4 - Estimating Supply Chain Integration with Demand Signal Processing

Robert Bray, Northwestern University, Kellogg School of Management, Evanston, IL, 60202, United States of America, robertlbray@gmail.com, Haim Mendelson

We study supply chain integration in the automotive industry, estimating how much auto manufacturers value stability in their suppliers' inventories. We find that: (i) the median auto manufacturer values stability in its suppliers' inventories 57% as much as stability in its own inventories, (ii) this integration reduces aggregate auto inventory variability by 44% the variability of demand, and (iii) the degree of integration increases significantly over the course of our sample.

■ SD45

Level 1 -101E

Sustainable Operations Management with Public Interest

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Michael Lim, Assistant Professor, University of Illinois, 1206 S. 6th Street, Champaign, IL, 61822, United States of America, mlim@illinois.edu

1 - Benchmarking for Improving the Efficiency of In-country Organizations in Global Health Supply Chains

Gemma Berenguer, Assistant professor, Purdue University, 403 W. State St., West Lafayette, In, 47907, United States of America, gemmabf@purdue.edu, Ananth Iyer, Prashant Yadav

Many data streams are used to characterize global health supply chain performance. These data reflect both input and output measurements and the combined effect of these variables describes overall delivery efficiency. In addition, comparing performance with peer organizations facing similar challenges provides both the best representation of performance and facilitates performance improvement through benchmarking. We employ Data Envelopment Analysis tools to accomplish this benchmarking goal.

2 - Optimal Location Problem of a Battery Switching Infrastructure Provider

Buket Avci, INSEAD, Fontainebleau, France, buket.avci@insead.edu, Serguei Netessine, Karan Girotra

We analyze the location problem of a battery-switching infrastructure provider for the deployment of electric vehicles. Using a simple population model of motorists and an economic model of provider-firm behavior, we find the optimal number of switching stations and their location. Our analysis captures tthe trade-off between number of stations and service level at these stations. We calibrate our model with reasonable parameter values and evaluate the feasibility of this business model.

3 - Extended Producer Responsibility (EPR) for Pharmaceuticals

Isil Alev, Georgia Institute of Technology, Atlanta, GA, United States of America, isilalev@gatech.edu, Atalay Atasu, Ozlem Ergun, Beril Toktay

EPR regulations, which hold producers physically and financially responsible for environmentally safe treatment of their end-of-life products, are gaining traction in context of managing unused pharmaceuticals. In our work, we build a game-theoretic model focusing on the interactions between manufacturers, insurance companies, physicians and patients to analyze the effectiveness of various EPR policies and uncover efficiency conditions for socially optimal pharmaceutical collection programs.

4 - Toward Mass Adoption of Electric Vehicles: Impacts of the Range and Resale Anxieties

Michael Lim, Assistant Professor, University of Illinois, 1206 S. 6th Street, Champaign, IL, 61822, United States of America, mlim@illinois.edu

We study the impact of two major psychological barriers to mass adoption of EVs, range and resale anxieties. Using a stylized model and a case study, we compare four business models in practice and obtain implications of consumer anxieties to parties involved in the EV industry. We show that the combination of battery owning and enhanced charging service, referred to as the (O,E) model, typically yields the best balance among the objectives of mass adoption, profitability, and consumer surplus.

■ SD46

Level 1 -101F

Global Supply Chain Finance

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Rene Caldentey, New York University, Stern School of Business, 44 West Fourth Street, New York, United States of America, rcaldent@stern.nyu.edu

1 - Global Sourcing Decisions for a Multinational Firm with Foreign Tax Credit Planning

Wenqiang Xiao, NYU, Stern School of Business, NYC, United States of America, wxiao@stern.nyu.edu, Vernon Ning Hsu, Joice Qiaohao Hu

We study sourcing decisions in a subsidiary of an MNF with FTCs planning. We show that an improvement in the firm's after-tax profitability, through tax cross-crediting, increased profit margin, or reduced tax rate, may induce the sourcing manager to order less, not more; and that the optimal sourcing decision under certain circumstances can be made without the knowledge of the demand distribution.

2 - Global Dual Sourcing under Exchange-rate Uncertainty

Shahryar Gheibi, Syracuse University, Whitman School of Management, 721 University Ave., Syracuse, NY, 13244, United States of America, sgheibi@syr.edu, Burak Kazaz, Scott Webster

We consider a firm's capacity reservation decisions under exchange rate and demand uncertainty. After observing exchange rates, the firm determines what capacity to utilize for manufacturing, but this decision is still made under demand uncertainty. We identify the set of potentially optimal solutions, and the conditions that lead to onshoring, offshoring, and dual sourcing.

3 - Randomized Supply Contracts

Rene Caldentey, New York University, Stern School of Business, 44 West Fourth Street, New York, United States of America, rcaldent@stern.nyu.edu, Martin Haugh

We study the performance of a supply chain with multiple competing retailers and a single Producer. We assume that retailers are budget-constrained and are therefore limited in the number of units they may purchase from the producer. We study the optimal design of time-dependent procurement contracts. We also quantify the value that financial markets bring to the operations of a cash-constrained supply chain.

■ SD47

Level 1 -101G

Patient Flows: Blocking and Readmissions

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Carri Chan, Assistant Professor, Columbia Business School, New York, NY, United States of America, cwchan@columbia.edu

1 - Surgery Scheduling and the Impact of Post-Anesthesia Care Unit Flow

Maya Bam, University of Michigan, Industrial and Operations Engineering, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, mbam@umich.edu, Brian Denton, Mark Van Oyen

Efficient surgery scheduling is vital for hospitals due to the high cost associated with surgeries, as well as for patients since adverse events can occur because of long wait times or operating room (OR) boarding. Surgery scheduling in multiple ORs considering downstream resources like the post-anesthesia care unit (PACU) has not been well studied. We present an optimization model that minimizes cost for the hospital while preventing blocking of the ORs due to overutilization of the PACU.

2 - From Process Changes to Reduced Re-admissions: A Financial ROIC Calculator for Project BOOST

Itai Gurvich, Associate Professor, Northwestern University, 2001 Sheridan Road, Evanston, IL, United States of America, i-gurvich@kellogg.northwestern.edu, Eric Park, Jan Van Mieghem, Jiajun Zhang

Project BOOST (Better Outcomes by Optimizing Safe Transitions), led by Northwestern Memorial Hospital, promotes a toolkit of process changes to reduce patient re-admissions. Our collaboration with the hospital studies how BOOST tools impact patient outcomes and financial results. A product of this collaboration is a return on investment calculator (ROIC). The ROIC assists hospital administrators in making informed decisions regarding the adoption of specific elements of the BOOST toolkit.

3 - Incentives in Healthcare: Predicting the Impact of Penalties for Hospital Re-admissions

Song-Hee Kim, PhD Candidate, Columbia University, New York, NY, United States of America, sk3116@columbia.edu, Ann Bartel, Carri Chan

Under the Affordable Care Act, hospitals with higher than expected 30-day readmissions for Heart Failure, Acute Myocardial Infarction, and Pneumonia will be financially penalized. Using retrospective data on patients enrolled in different Medicare programs (e.g., Fee-for-service and Medicare Advantage), we develop an understanding of the potential impact of the new legislation and how it relates to the interplay between financial and medical incentives in the provision of hospital care.

4 - Incentive Mechanisms in Healthcare

Mohsen Bayati, Assistant Professor, Stanford University, Graduate School of Business, Stanford, United States of America, bayati@stanford.edu, Mark Braverman, Ramakrishna Gummadi, Ramesh Johari

We investigate healthcare provider payment mechanisms with the aim of incentivizing optimal provider behavior. We show that adding a small performance-based incentive on top of the existing mechanisms can have a dramatic effect on overall efficiency. Our results provide theoretical support for the recent push by Center for Medicare and Medicaid Services to add small performance-based incentives into its reimbursement system.

■ SD48

Level 1 -101H

Behavioral Operations in Healthcare

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Robert Batt, Assissant Professor, University of Wisconsin-Madison, 975 University Ave., Madison, WI, 53706, United States of America, batt@wharton.upenn.edu

1 - Beyond Staffing Numbers: The Effect of Skill-mix, Cohesion and Leadership on Adverse Events

Stefan Scholtes, Professor, University of Cambridge, Trumpington Street, Cambridge, United Kingdom, s.scholtes@jbs.cam.ac.uk, Sandra Sülz

Despite considerable research efforts, managerial recommendations concerning the link between hospital nurse staffing and patient outcomes remain inconclusive. While most research has focused on numbers of staff, we argue that team variables, such as skill-mix, cohesion and leadership, are just as relevant for the prevention of adverse events in hospitals. Our empirical study is based on three years of patient-level and employee-level data of a neuroscience division in a large general hospital.

2 - Waiting Patiently: An Empirical Study of Queue Abandonment in an Emergency Department

Robert Batt, Assissant Professor, University of Wisconsin-Madison, 975 University Ave., Madison, WI, 53706, United States of America, batt@wharton.upenn.edu, Christian Terwiesch

We study abandonment from an emergency department queue and find that patients are influenced by what they observe in the waiting room: census, arrivals, and departures. Patients also make inferences about the severity of the patients around them and respond differently to people sicker and less sick moving through the system. These results show that in order to reduce patient abandonment, hospitals should carefully manage what information patients have regarding their wait.

3 - Cohort Turnover and Productivity: The July Phenomenon in Teaching Hospitals

Hummy Song, PhD Student, Harvard Business School, Morgan Hall 480, Soldiers Field Road, Boston, MA, 02163, United States of America, hsong@hbs.edu, Jason Barro, Robert Huckman

We consider the impact of cohort turnoverôthe planned simultaneous exit of a large number of experienced employees and a similarly sized entry of new workersóon productivity. Specifically, we examine the impact of the annual July turnover of residents in American teaching hospitals on levels of resource utilization and quality. We find that this turnover results in increased resource utilization in minor and major teaching hospitals and decreased quality in major teaching hospitals.

4 - The Effect of Health Plan Type on The Computed Tomography (CT) Utilization

Sarah Zheng, Doctoral Student, Boston University, 16 Gold Star Rd., Cambridge, MA, 02140, United States of America, xinzheng@bu.edu, Z. Justin Ren

In this paper, we look into the effects of health plan type on the CT utilization using Thomson-Reuters MarketScan database. We found that Health Maintenance Organization, Consumer-Driven Health Plan, High Deductible Health Plan have lower CT utilization comparing with Preferred Provider Organization. This study provides empirical evidence on how different payment systems may help reduce overutilization.

■ SD49

Level 1 -101I

Modeling Choice

Cluster: Tutorials

Invited Session

Chair: Vivek Farias, Professor, Massachusetts Institute of Technology, 100 Main Street, Cambridge, MA, 02142, United States of America, vivekf@mit.edu

1 - Modeling Choice

Vivek Farias, Professor, Massachusetts Institute of Technology, 100 Main Street, Cambridge, MA, 02142, United States of America, vivekf@mit.edu

Choice modeling has become germane to the practice of Revenue Management in multiple industries. The next frontier of challenges appears to be in making the practice of choice modeling more 'data driven' than it currently is. This tutorial will survey the modeling landscape and discuss estimation methodologies and their limitations. Connections with a host of applications, both traditional and modern will be stressed.

■ SD50

Level 1 -101J

Electric Power Markets for Managing Variable Solar and Wind Energy

Cluster: Climate Change and OR

Invited Session

Chair: Ben Hobbs, Director, E2SHI, The Johns Hopkins University, Baltimore, MD, United States of America, bhobbs@jhu.edu

1 - Effect of Market Rules on Generation Investments in Power Systems with Significant Renewables

Mort Webster, Massachusetts Institute of Technology, Cambridge, MA, United States of America, mort@mit.edu, Fernando de Sisternes, Jose Ignacio Perez-Arriaga

We use a capacity expansion model with unit commitment constraints to find the socially optimal generation mix for a given penetration of intermittent renewables. For this mix, we calculate hourly day-ahead prices and cash flows for all units in the system under alternative market rules for treating startup costs. We demonstrate the impacts of operating a mix with more renewables than it was designed for. Results from this analysis will allow assessing the shortcomings of current market rules.

2 - Utilization of Hydroelectric Dams for Wind Integration

Seth Blumsack, Associate Professor, Pennsylvania State University, John and Willie Leone Family Department, University Park, PA, 16802, United States of America, sethb@psu.edu, Patrick Reed, Alisha Fernandez

We model the decision of a multi-use hydroelectric dam to provide wind integration services, scheduled energy production and ecosystem services through controlled releases. Even if wind integration services are priced substantially higher than current ancillary services, multi-use dams face operational constraints in providing wind integration services. These operational constraints are exacerbated during periods of drought.

3 - Synthesizing Wind Data to Integrate into Grid Planning and Policy Making Models

Michael Ferris, Professor, University of Wisconsin, Computer Sciences Department, Madison, WI, United States of America, ferris@cs.wisc.edu, Lisa Tang

Current operational policies are inadequate to deal with the increasing usage of wind power in the United States. Based on data gathered by NREL of forecasted and realized wind power, we present a framework that integrates statistical methods for modeling dynamics of wind power with economic planning and policy models.

4 - On the Problem of Investment in SREC Markets

Javad Khazaei, Post Doctoral Fellow, Princeton University, Dept. OR & Financial Engineering, Princeton, NJ, United States of America, jkhazaei@princeton.edu, Michael Coulon, Warren Powell

SREC market prices have been proven to be extremely volatile in the past few years. This has caused higher risk and less investment in solar power generation. We propose an original SREC price model, and provide a dynamic programming solution algorithm. Our model includes a feedback mechanism for generation response to market prices. Finally, after calibrating our model to reproduce historical prices, we analyse and propose alternative market mechanisms capable of improving market performance.

■ SD51

Level 1 -102D

Public Transit System Routing and Assignment

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Nicholas Lownes, Assistant Professor, University of Connecticut, Transportation and Urban Planning, Castleman Building Rm 331, nlownes@engr.uconn.edu

1 - Model and Solution Algorithm for Schedule-based Transit Assignment

Alireza Khani, University of Arizona, 1209 E. Second Street, Room 206A-1, Tucson, AZ, 85721, United States of America, akhani@email.arizona.edu, Mark Hickman

An optimization model is proposed for passenger assignment in schedule-based transit networks. The model uses logit route choice and takes into account transit vehicles capacity to model user behavior more realistically. A simulation-based assignment algorithm is developed to solve the model efficiently and application in a large network is provided.

2 - Redesigning Routes in Bus Rapid Transit (BRT) Systems using Variable Neighborhood Search (VNS)

Jaime E. Gonzalez, Instructor, Universidad de los Andes, Departamento de Ingenierìa Industrial, Bogota, Colombia, je.gonzalez30@uniandes.edu.co, Andrés L. Medaglia

The BRT route redesign problem consists of modifying a set of operational routes to minimize the current congestion on the network, while satisfying the technical constraints of the BRT system. We propose a matheuristic that synergistically couples a mathematical program and a VNS. The VNS takes information from the output of the mathematical program to guide the search efficiently. We present computational results on realistic BRT topologies.

3 - Optimizing Ridesharing Services for Airport Access

Lei Feng, University of Maryland, 1173 Glenn L. Martin Hall, University of Maryland, College Park, MD, 20742, United States of America, lfeng@umd.edu, Elise Miller-Hooks, Paul Schonfeld, Matthew Mohebbi

The vehicle routing and scheduling problem faced by the Supreme Airport Shuttle, Inc. that provides ridesharing services to customers to and from the airport is explored. Mathematical models and solution algorithms are developed for three operational policies. Computational experiments based on real-world data are designed to evaluate proposed solution algorithms and assess various performance measures for different operational policies.

4 - A Tabu Search-based Heuristic Method for a Multi-objective Bus Stop Location Problem

Sha Mamun, Graduate Student, University of Connecticut, 261 Glenbrook Road, Unit 3037, Storrs, CT, 06269-3037, United States of America, msm08014@engr.uconn.edu, Nicholas Lownes

A multi-objective bus stop location problem is presented to optimize service efficiency by considering service accessibility and trip connectivity. A tabu search algorithm for solving this problem is proposed. The problem consists in identifying optimal stop locations, assigning buses to the routes and allocation of trip demands from each stop to all origin-destination pairs.

■ SD52

Level 1 -102E

Urban and Green Logistics

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Tom van Woensel, Full professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, T.v.Woensel@tue.nl

1 - Branch and Price for the Pollution-routing Problem

Tom van Woensel, Full professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, T.v.Woensel@tue.nl

We propose an exact solution for the PRP based on a branch-and-price algorithm. Considering speed as a decision variable significantly complicates the pricing problem as the dominance test becomes harder. We solve the pricing problem by means of a tailored labeling algorithm. Moreover, we introduce a tailored dominance set. Computational results are presented.

2 - Meta-heuristic for Multi-trip Pickup & Delivery Problem with Time Windows and Synchronization

Teodor Gabriel Crainic, Professor, School of Management & CIRRELT, Universite du Quebec a Montreal, Montreal, PW, Canada, TeodorGabriel.Crainic@cirrelt.ca, Michel Toulouse, Phuong Nguyen Khanh

Multi-zone Multi-trip Pickup and Delivery Problem with Time Windows and Synchronization (MZT-PDTWS) aims to address the integration of outbound traffic with the "classical" inbound traffic into a single city logistic system. We present the problem description and a meta-heuristic for the MZT-PDTWS.

3 - Combining Passenger and Freight Transportation with Public Scheduled Line Services

Veaceslav Ghilas, Eindhoven University of Technology, Eindhoven, Netherlands, v.ghilas@tue.nl, Tom van Woensel, Emrah Demir

The Pickup and Delivery Problem (PDP) with public scheduled line services concerns scheduling a set of vehicles to serve two types of requests (passengers and freight). Part of the freight journey can be carried on scheduled public transportation. We propose an arc-based mixed integer programming formulation which is solved to optimality using CPLEX. Computational results provide a clear understanding of the benefits of combining passenger and freight transportation in current networks.

4 - A Sampling Approach for Minimizing Emissions in Urban Logistics
Jan Fabian Ehmke, Assistant Professor, Freie Universität Berlin, Garystr. 21, Berlin, 14195, Germany, JanFabian.Ehmke@fu-berlin.de, Ann Campbell, Barrett Thomas

We discuss the determination of emissions optimized paths in urban areas. Here, frequent changes of speed as often observed in peak times increase emissions significantly. To this end, Dijkstra's algorithm is extended by time-dependent sampling, which allows for more realistic estimation of emission and arrival time functions. Based on a large real-world data set, results will show that our approach yields less emissions than common distance and travel based optimization.

■ SD53

Level 1 -102F

Facility Logistics III

Sponsor: Transportation Science & Logistics/Facility Logistics

Sponsored Session

Chair: Sadan Kulturel-Konak, Professor of Management Information System, Pennsylvania State University, Tulpehocken Rd., PO Box 7009, Reading, PA, 19610, United States of America, sadan@psu.edu

1 - Optimization of Vaccine Packaging and Storage to Improve Vaccine Supply Chain Logistics
Bryan Norman, banorman@pitt.edu, Jayant Rajgopal, Shawn Brown, Jung Lim, Bruce Lee, Sunghoon Lim, Erin Claypool

Cold storage space is a significant constraint in many vaccine supply chains. We consider the problem of determining vaccine packaging quantities and storage configurations in order to optimize cold storage space utilization with an emphasis on lower and middle income countries EPI vaccine distribution systems. Results are shown for different country contexts.

2 - Optimal Conversion of an Evacuation Network to Signalized and Uninterrupted Flow Intersections
Yue Liu, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee, Milwaukee, WI, United States of America, liu28@uwm.edu, Zhenke Luo

This article presents a mathematical model with a parametric variational inequality (VI) formulation of equilibrium constraints to optimize the selection and distribution of signalized and uninterrupted flow intersections for strategic planning of an emergency or special event. An efficient heuristic approach embedded with a diagonalization algorithm is developed to yield the meta-optimal solutions.

3 - Optimal Partitioning of Vertical Zones in Vehicle-based Warehouse System
Debjit Roy, Assistant Professor, Indian Institute of Management Ahmedabad, Wing 3C, Vastrapur, India, debjit@iimahd.ernet.in, Anand Kumar

Autonomous Vehicle-based Storage and Retrieval (AVS/R) system offer greater flexibility and responsiveness in processing unit-load S/R transactions in high-density storage areas. This research is a first attempt to model a "zone-captive" AVS/R system and understand the effect of number and boundary of vertical zones on system performance measures.

4 - A Two-sided GridPick System
Kevin R. Gue, Associate Professor, Auburn University, Shelby Center Room 3314, Auburn, AL, 36832, United States of America, Guekevi@auburn.edu, Onur Uludag

GridPick is a high-density, puzzle-based order picking system that moves items to and away from the pick face dynamically. The benefit is having effectively more than one sku per picking slot, which reduces walking time to build orders. In this talk, we present a two-sided system in which workers can pick from the North and South sides of the grid at the same time.

■ SD54

Level 1 -103A

New Modeling Strategies for Transportation Infrastructure

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Pablo Durango-Cohen, Associate Professor, Northwestern University, 2145 Sheridan Road, A332, Evanston, IL, 60202, United States of America, pdc@northwestern.edu

1 - Using Remote Sensors to Support Health-monitoring and Management of Transportation Infrastructure
Pablo Durango-Cohen, Associate Professor, Northwestern University, 2145 Sheridan Road, A332, Evanston, IL, 60202, United States of America, pdc@northwestern.edu, Yikai Chen

Motivated by recent technological advances, we describe the development and validation of a statistical process control framework to support health-monitoring and management of transportation infrastructure. The framework consists of formulation of statistical models to explain/predict common-cause variation, and use of multivariate control charts to detect special-cause variation. We present numerous examples to validate the framework.

2 - Lane Use Management Strategies
Chaitanya Paleti, NexTRANS Research Center, Purdue University, 3000 Kent Avenue, West Lafayette, IN, United States of America, cpaletis@purdue.edu, Srinivas Peeta

This study presents the results of micro-simulation based analysis to study the feasibility of lane use management strategies. Ramp metering, high occupancy vehicle (HOV) lanes and reversible lanes are three strategies analyzed using VISSIM for an I-65 corridor. Insights from the analysis are linked to the decision-making process of implementing the lane use management strategies.

■ SD55

Level 1 -103B

Resource Location and Management in Emergency Planning and Operations

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Raha Akhavan-Tabatabaei, Assistant Professor, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, Colombia, r.akhavan@uniandes.edu.co

1 - Empirical and Simulation Analysis of Volunteer Convergence Following a Large-Scale Disaster
Emmett Lodree, The University of Alabama, 361 Stadium Drive, Tuscaloosa, AL, United States of America, ejlodree@cba.ua.edu, Lauren Davis

Volunteer convergence in response to large-scale disasters often overwhelms the agencies responsible for managing relief efforts. Using data collected during the 2011 tornado relief efforts in Tuscaloosa Alabama, this study characterizes the stochastic processes relevant to convergence within the context of a disaster-relief warehouse queuing system. Volunteer task assignment policies are also examined through simulation experiments.

2 - Dynamic Resource Allocation Problem for Transportation Network Evacuation
Xiaozheng He, Research Associate, Purdue University, NEXTRANS Center, 3000 Kent Ave., West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu, Srinivas Peeta

This study proposes a mixed integer linear program (MILP) model to allocate movable resources dynamically to a transportation network to improve evacuation operational efficiency. To enable realism for practical operations, the proposed model involves constraints on resource reallocation time and minimum time at a location. By transforming the problem into a two-stage optimization problem, we develop a greedy-type heuristic algorithm to solve the MILP approximately but efficiently.

3 - Real-time Policies for Post-disaster Urban Search and Rescue Team Deployment

Mersedeh TariVerdi, Ph.D. Candidate, University of Maryland - College Park, ENCE Department,1173 Glen L. Martin Hall, University of Maryland, College Park, 20742, United States of America, mercedeh.t@gmail.com, Elise Miller-Hooks, Matti Adan

In post-disaster circumstances, decisions related to the deployment of urban search and rescue (USR) resources must be taken quickly in the face of uncertainty. Thus, simple-to-follow protocols for resource management are needed for efficient response. In this study, real-time strategies for assigning USR teams to work sites are developed and evaluated against optimal off-line strategies. These strategies build on expert knowledge and existing prioritization methods.

4 - Location-allocation under Uncertainty Applied to Disaster Operations Management

Raha Akhavan-Tabatabaei, Assistant Professor, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, Colombia, r.akhavan@uniandes.edu.co, Andrés L. Medaglia, Ridley Morales

Strategically locating emergency response facilities based on regional risk maps can reduce the impact of a disaster on communities. We model a general location-allocation problem for emergency response as a capacitated facility location problem under uncertainty. To solve the model, we use two-stage stochastic programming with side constraints to minimize the total expected cost and limit the downside risks. We illustrate our methodology using data from the city of Bogot· (Colombia).

■ SD56

Level 1 -103C

Controllability of Renewable Energy Systems

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Janet Allen, Professor, Univesity of Oklahoma, 202 W. Boyd Street, Room 116-G, Norman, OK, 73019-1022, United States of America, janet.allen@ou.edu

Co-Chair: Victoria C Chen, The University of Texas at Arlington, Dept. of Indus. & Manufac. Sys. Engr., Arlington, TX, 76019, United States of America, vchen@uta.edu

1 - Adaptive Design for PHEV Electric Charging Stations: Considering Impact of Demand on Service Level

Amirhossein Khosrojerdi, The University of Oklahoma, 202 W. Boyd St., Room 124, Norman, OK, United States of America, akhosrojerdi@ou.edu, Janet Allen, Farrokh Mistree, Shabnam Rezapoor, Paul Hoang

We propose a two-step method to design an adaptive system for electric charging stations. First, a multi-attribute regression model based on a discrete-event simulation is developed to model the impact of PHEV demand on the service level of charging stations. Second, a multi-objective, mixed-integer, non-linear model is formulated to find the location, number of chargers and capacity of charging stations, and the allocation of electricity between charging stations and demand nodes.

2 - Wind Power Forecasting toward the Adaptive Design of PHEV Charging Stations by SVM

Piampoom Sarikprueck, University of Texas at Arlington, 416 Yates Street, Nedderman Hall Room 517-518, Arlington, TX, 76019, United States of America, piam_13@hotmail.com, Asama Kulvanitchaiyanunt, Victoria C Chen, Jay Rosenberger, Wei-jen Lee

The design of a PHEV charging station with advanced control algorithm and distributed storage devices is proposed to maximize the utilization of the renewable energy and provide supports to the grid. To improve the performance of the charging station, the predictions of availability and/or prices of energy sources are essential. This research discusses the wind power forecasting using Support Vector Machines (SVM). Future research will study the prediction of solar energy and market prices.

3 - Control for a System of PHEV Charging Stations

Asama Kulvanitchaiyanunt, University of Texas at Arlington, 500 West First Street, 420 Woolf Hall, Arlington, TX, 76019, United States of America, asama.kulvanitchaiyanunt@mavs.uta.edu, Victoria C Chen, Jay Rosenberger, Wei-jen Lee, Janet Allen, Amirhossein Khosrojerdi, Piampoom Sarikprueck, Farrokh Mistree

Dynamic control of a system of plug-in hybrid electric vehicle (PHEV) charging stations is studied. As an initial analysis, the mean value problem is formulated as a deterministic linear program. Multiple linear regression is used to estimate the relationship between the objective function and station locations with number of slots per station. Future work discusses a value iteration approach based on design and analysis of computer experiments to solve the infinite-horizon dynamic program.

4 - Design for Controllability: Controllability for Complex Networks under Failures

Amirhossein Khosrojerdi, The University of Oklahoma, 202 W. Boyd St., Room 124, Norman, OK, United States of America, akhosrojerdi@ou.edu, Farrokh Mistree, Krishnaiya Thulasiraman, Janet Allen

We develop a three-step method to consider the impact of structural controllability on designing systems. First, a method based on Decision Support Problem (DSP) is used to generate a set of system design alternatives. Second, a graph-theoretic method based on the cactus notion is proposed to find sufficient conditions for a system to be structurally controllable. Finally, cDSP is applied to design structural controllable systems.

■ SD57

Level 1 -103D

Analytics in the Petrochemical and Petroleum Industries, Taking a Step Back - Supported by the Petrochemical and Petroleum Subgroup of ENRE

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Marlize Meyer, Principal Operations Researcher, Sasol Technology, 1 Klasie Havenga str, Sasolburg, 1947, South Africa, marlize.meyer@sasol.com

1 - Modeling the North American Market for Natural Gas Liquids

Robert Brooks, President, RBAC, Inc., 14930 Ventura Blvd, Suite 210, Sherman Oaks, CA, 91364, United States of America, rebrooks@rbac.com

NGL-NA is a multi-commodity model of the North American market for natural gas liquids. It models NGL supply, processing, fractionation, transportation, and demand for each commodity. NGL-NA uses optimization techniques to forecast monthly flow volumes and prices of each of the various commodities through existing, planned, and prospective infrastructure. The presentation will describe the mathematical model, its solution algorithms, preliminary results and further development plans.

2 - Trailer Fleet Planning for Industrial Gas Distribution

Yazhe Feng, Research Scientist, Air Liquide, 200 GBC Drive, Newark, DE, 19702, United States of America, Yazhe.Feng@airliquide.com

Fleet planning is important to the financial and operational performance of industrial gas providers. This research considers vehicle purchase, relocation, and rental decisions to minimize total distribution costs and fleet investment costs over multiple time periods and multiple depots. A two-phase approach is proposed to solve the real-life problem efficiently. Numerical studies, conducted using an industrial dataset, demonstrate the effectiveness and efficiency of the two-phase approach.

3 - Using Stochastic Simulation to Assess Operability and Availability of a Unique New Chemical Plant

Prenitha Pooren, Sr Operations Researcher, Sasol Technology, 1 Klasie Havenga str, Sasolburg, 1947, South Africa, Prenitha.Pooren@sasol.com

Sasol is constructing the world's first commercial ethylene tetramerisation unit. Beneficial operation of the plant will be reached late 2013. Being a new technology, questions regarding the sizing of the plant equipment, availability, operations and associated risks were raised. Simulation was identified as the best risk mitigation tool to provide answers. Behaviour of this complex integrated system was investigated and variance-based sensitivities were determined.

■ SD58

Level 1 -103E

Applications in Mining

Sponsor: Energy, Natural Res & the Environment/ Forestry/Mining

Sponsored Session

Chair: Alexandra Newman, Associate Professor, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Underground Mine Production Schedule Optimization with Ventilation

Andrea Brickey, PhD Fellow, Colorado School of Mines, Mining Engineering Department, 1500 Illinois Street, Golden, CO, 80401, United States of America, abrickey@mines.edu, Alexandra Newman

Traditional underground mine schedules have been based solely on production limitations (equipment, hoisting, and milling capacities). We present a new, more holistic approach to underground mine planning by incorporating ventilation, resulting in a large-scale integer optimization model that maximizes discounted gold extraction. Constraints include typical (linear) precedence and resource capacities, and ventilation capacities. We provide preliminary computational results.

2 - Logistic Planning for the Mining Company LKAB

Mikael Ronnqvist, Professor, Université Laval, Pavillon Adrien-Pouliot, 1065, Avenue de la Médecine, Quebec, QC, Canada, mikael.ronnqvist@gmc.ulaval.ca, Dick Carlsson, Patrik Flisberg

LKAB is a large iron ore mining company and a world-leader in pellet manufacturing. It produces more than 20 million tons which is transported with trains to two harbours. In order to increase the production, LKAB needs to optimize its train logistics. We report on a modeling system and experiences that is used to schedule locomotives and wagons including maintenance. This is the basis for what-if-scenarios including new locomotives, new terminals and the opening of two mines.

3 - Open Pit to Underground: Optimizing the Transition

Barry King, Graduate Student, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, barking@mines.edu

Current industry practice of scheduling extraction in an open pit mine, followed by making underground extraction decisions for the same deposit, leads to suboptimal extraction in the transition zone. We can use an optimization model to determine these decisions for maximizing net present value for the mining operation, and adhering to precedence and operational constraints. We illustrate our technique numerically and contrast our work with previous less detailed and/or less formal efforts.

4 - Price and Ore Uncertainty on the Ultimate Pit Problem

Daniel Espinoza, Assistant Professor, University of Chile, Av. Republica 701, Santiago, 8370439, Chile, daespino@gmail.com, Eduardo Moreno, Marcos Goycoolea

In this talk, we will present ongoing research on stochastic or uncertain open pit planning, either on ore-grade estimation, or in price. We compare several standard risk models (VaR, CVaR and others) by using either the Sample Average Approximation (SAA) technique, and robust counterparts of some simple formulations. We will focus on the strengths and drawbacks of the proposed techniques, and intensive computational experiments for the analysis.

■ SD59

Level 1 -103F

Ecosystem Conservation and Sustainability

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Hayri Onal, Professor, University of Illinois at Urbana-Champaign, 1301 W. Gregory Dr., 305 Mumford Hall, Urbana, IL, 61801, United States of America, h-onal@illinois.edu

1 - Fuel Management for Wildfire Hazard Reduction with Spatial and Temporal Ecological Requirements

James Minas, RMIT University, GPO Box 2476, Melbourne, 3001, Australia, james.minas@rmit.edu.au, John Hearne

We present a mixed integer programming model for multi-period fuel treatment scheduling that generates fire resistant spatial fuel patterns. Our model incorporates ecological requirements such as: minimum and maximum treatment intervals, requisite habitat growth stage proportions, and spatial contiguity and compactness of habitat.

2 - Controllability of Complex Networks for Sustainable System Dynamics

PaholaThathiana Benavides Gallego, Ph.D Student, University of Illinois at Chicago, 55 West Chestnut Apt3006, Chicago, 60610, United States of America, tati1821@hotmail.com, Urmila Diwekar, Heriberto Cabezas

In this paper, we study the sustainability of our planet represented in three dynamic systems. These systems consist on ecosystem models that mimic the dynamic behavior of the Earth. We determined the minimum numbers of nodes needed to control those systems. In this sense, we argue that controllability of these systems is very important to determining their long term sustainability.

3 - Controlling the Invasion of Sericea with Limited Budgets: Insights from an Optimization Model

Esra Buyuktahtakin, Assistant Professor, Wichita State University, 1845 Fairmount St., Wichita, 67260, United States of America, Esra.Buyuktahtakin@wichita.edu, Rajesh Kumar Narasimhan, Halil Cobuloglu, Tanner Lampe, Greg Houseman

Native grasslands in the Great Plains are threatened by the spread of sericea (Lespedeza cuneata), an invasive weed from Asia. Using empirical data, we develop an optimization model, which accounts for population growth rates, carrying capacity, seed dispersal, treatment costs, and economic loss due to invasion. The model determines economically efficient treatment strategies for land owners and government officials for controlling sericea invasion.

4 - Multi-objective Sustainable Facility Location

Josue Velazquez-Martinez, Eindhoven University of Technology, Netherlands, josue.velazquez@itesm.mx, Jaime Mora-Vargas, Edgar Blanco, Jan Fransoo

We formulate a multi-objective combinatorial optimization problem to locate a distribution center in a dense urban environment. We characterize the SFL problem and present an efficient metaheuristic to approximate the Pareto frontier. We conduct an experimental study for a for a CPG company in Mexico City to demonstrate the applicability of our model.

■ SD60

Mezzanine - 100A

Data Mining Applications I

Sponsor: Data Mining

Sponsored Session

Chair: Oguz Cimenler, University of South Florida, 4202 E. Fowler Ave., Tampa, FL, 33620, United States of America, ocimenle@mail.usf.edu

1 - An Evaluation of Collaborative Research in College of Engineering: Social Network Approach

Oguz Cimenler, University of South Florida, 4202 E. Fowler Ave., Tampa, FL, 33620, United States of America, ocimenle@mail.usf.edu, Kingsley A. Reeves

This research investigates how the structural aspects of the communication network constructed based on information from researchers' conversation (or advice) exchanges differ from the structural aspects of the network constructed based on information from researchers' collaborative output (e.g. co-authored publications, joint grant proposal, and joint patent applications). Results of this study have the potential to provide information for policy formulations in collaborative research.

2 - Evaluation of City-production Integration Based on Factor Analysis and Cluster Analysis

Lin Su, Tongji University, School of Economic and Management, French Center A403, Shanghai, China, yjshsl@163.com, Xia Wang, Bing Guo, Xin Zheng, Xue Li

The level of city-production integration is essential for urban development; however the current research mainly focuses on the definition of the concept. In this paper, we took nationwide high-tech zone of the major cities as cases by using the combination of factor analysis and cluster analysis to quantitatively evaluate and classify the level of city-production fusion, and finally proposed policy recommendations.

■ SD61

Mezzanine - 100B

Degradation Modeling under Dynamic Environments and Preventive Maintenance II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Xiao Liu, Research Staff Member, IBM Research Collaboratory Singapore, 9 CBP 1, The IBM Place, Singapore, 486048, Singapore, liuxiao@sg.ibm.com

1 - Condition-based Maintenance for Multiple Stents with Stochastic Dependent Failure Processes

Elias Keedy, University of Houston, Houston, United States of America, eliekeedy@yahoo.com, Qianmei Feng, Koosha Rafiee, David Coit

Based on the physics-of-failure of stents, we develop a system reliability model that considers the stochastic processes for two dependent failure processes in a multi-stent system in human arteries. System reliability functions are derived for two patient groups with different activity levels. Condition-based maintenance models are developed to minimize the impact of failures of stents. In-vitro fatigue testing data will be presented to analyze the crack growth of this emerging technology.

2 - Multiple Objective Optimization for Degrading Systems - Liquefied Natural Gas (LNG) Pipeline

David Coit, Industrial and Systems Eng, Rutgers University, Piscataway, United States of America, coit@rci.rutgers.edu, Sanling Song, Qianmei Feng

LNG pipeline reliability is analyzed based on dependent competing failure processes and multi-objective optimization. LNG pipeline failure can pose significant threat to people and property in vicinity of failure. Some failures are time independent, e.g., mechanical interference by third party, earthquake or overpressure, while other failures are time dependent e.g., corrosion or fatigue failures.

3 - A Degradation Model of Solar Panel Efficiency under Dynamic Conditions

Xiao Liu, Research Staff Member, IBM Research Collaboratory Singapore, 9 CBP 1, The IBM Place, Singapore, 486048, Singapore, liuxiao@sg.ibm.com

Based on real experimental data, a statistical degradation model is developed for solar panel efficiency at dynamic environmental conditions. We also compare our model to conventional degradation models without considering the environmental conditions.

■ SD62

Mezzanine - 100C

Nanomanufacturing and Nanoinformatics II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Ave., GER 240, Los Angeles, CA, United States of America, qiang.huang@usc.edu

Co-Chair: Tirthankar Dasgupta, Harvard University, 1 Oxford St., Dept of Statistics, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu

1 - A Framework for Understanding Uncertainty in Graphene Growth Process Modeling

Sobambo Sosina, Graduate Research Assistant, Harvard University, 1 Oxford St., 7th floor, Cambridge, MA, 02138, United States of America, sosina@fas.harvard.edu, Tirthankar Dasgupta, Qiang Huang, Jian Wu

Graphene has many important properties and has been identified as a very efficient and cheap ingredient in a lot of industrial applications. Unfortunately, there has not been much work done in understanding the kinetics that drive the graphene growth process. We propose a rate-based model that correctly quantifies the uncertainty in our model parameters. We further extend the graphene shape model to account for possible spatial dependence using a lattice spatial model.

2 - Design of Scale-up Engineering Experiments

Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Ave., GER 240, Los Angeles, CA, United States of America, qiang.huang@usc.edu, Li Wang

Engineering processes often are scale-dependent. They likely behave differently on a smaller scale in a laboratory than on a larger scale in full production. We propose a strategy to explore the similarity space in order to identify suitable regions for system scale-up. The strategy is demonstrated with the study of drag on a sphere in fluid. Applications can be extended to scale-up nanomanufacturing.

3 - On-line Steady-state Detection Based on Multiple Change-point Models using Particle Filters

Jianguo Wu, University of Wisconsin, Milwaukee, WI, United States of America, wu45@wisc.edu, Shiyu Zhou, Xiaochun Li, Yong Chen

Steady-state detection is critical in process performance assessment, fault detection and process control. We proposed a robust on-line steady-state detection algorithm using multiple change-point model and particle filtering techniques. The steady-state detection problem is formulated as a multiple change-point problem using a segmental linear model.

■ SD63

Mezzanine - 100D

Multivariate Statistical Analysis for Reliability Improvement

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jian Liu, The University of Arizona, 915 North Tyndall Avenue, Tucson, AR, 85721, United States of America, jianliu@email.arizona.edu

1 - Degradation Data Analysis using Nonlinear Mixed-effects Models via Shape-restricted Splines

Yili Hong, Assistant Professor, Virginia Tech, Blacksburg, VA, United States of America, yilihong@vt.edu, Zhibing Xu

With current technology, environmental variables and usage information can be easily recorded over time. It is important to incorporate those environmental variables into the degradation path. Physical knowledge often suggests nonlinear degradation path. We propose a nonlinear mixed effects model incorporating with dynamic covariates to model the degradation path. Shape-restricted splines are used and an alternating algorithm is proposed. An outdoor weathering dataset is used for illustrations.

2 - Modeling Reliability of Heterogeneous Products with Semi-latent Hazard Regression

Mingyang Li, Research Assistant, University of Arizona, Tucson, AZ, United States of America, mingyangli@email.arizona.edu, Jian Liu

Heterogeneity of final product population makes the reliability modeling based on homogeneous assumption unacceptable. Such heterogeneity, conventionally modeled as unknown parameters or unobservable random variables, may be caused by the variations. This paper proposes a semi-latent hazard regression (SLHR) model to explicitly quantify the impact of manufacturing process variation on reliability heterogeneity. The advantages of applying the SLHR model in burn-in process are discussed.

3 - Prediction and Prognosis of Time to Obstructive Sleep Apnea (OSA) Onset

Satish Bukkapatnam, Professor, Oklahoma State University, 322 Engineering North, Oklahoma State University, Stillwater, OK, United States of America, satish.t.bukkapatnam@okstate.edu, Trung Le

We introduce a Dirichlet process-based mixture Gaussian process model to predict the onset of OSA episodes and to derive the distribution of the time to the apneic onset using a stochastic network representation of the dynamical transition and topology of the phase-space reconstructed from the multivariate degradation-based sensory signals. Extensive test suggests that the accuracies (R2) for 1-3 min ahead predictions are 83%-77%, and average prediction of expected time to apneic onsets is 72%.

4 - Reliability Analysis for Dependent Competing Risk Processes with Degradation Rate Transition

Qianmei Feng, Associate Professor, University of Houston, E206 Engineering Building 2, Houston, United States of America, qfeng@central.uh.edu, David Coit, Koosha Rafiee

We develop reliability models for systems subject to dependent risks of degradation and random shocks with a degradation rate transition according to particular random shock patterns. The degradation rate can change when the system becomes more susceptible to fatigue and deteriorates faster, as a result of withstanding shocks. We consider four different shock patterns that can increase the degradation rate: (1) extreme shock model; (2) d-shock model; (3) m-shock model; and (4) run shock model.

■ SD64

Mezzanine - 100E

Patient-Centric Healthcare Delivery I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abe Zeid, zeid@coe.neu.edu

Co-Chair: Sagar Kamarthi, United States of America, sagar@coe.neu.edu

1 - Maximizing the Value of Healthcare Output through Learning

Renato de Matta, Associate Professor, University of Iowa, 108 PBAB, Iowa City, IA, 52242, United States of America, renato-dematta@uiowa.edu

We develop a model to find the number and type of patients to assign physicians that will maximize the value of healthcare output per input expended in treatment through learning. We apply our model to plan the workload of LASIK eye surgeons. Computational results are presented.

2 - A Strategic Tool for Achieving Compatibility between Quality and Supply Chain Drivers in Healthcare Industry

Gangaraju Vanteddu, Southeast Missouri State University, Cape Girardeau, MO, United States of America, gvanteddu@semo.edu

With the emphasis shifting to reduce the healthcare delivery costs ,while improving the quality at the same time , it is essential to consider different interfaces between important supply chain cost drivers and the relevant quality drivers in a given context. In this research, a strategic tool is presented for identifying the degree of compatibility between the quality and supply chain drivers to facilitate effective decision making.

3 - A Scenario-based Approach for Operating Theater Scheduling under Uncertainty

Nickolas Freeman, PhD Candidate, University of Alabama, Box 870226, Tuscaloosa, AL, 35487, United States of America, nkfreeman@cba.ua.edu, Sharif Melouk, John Mittenthal

We schedule elective surgical procedures with duration uncertainty in operating rooms while maintaining flexibility to service urgent procedures before a user specified duration elapses. A mixed integer programming (MIP) formulation incorporates the uncertainty by determining a global operation schedule that satisfies multiple sets of scenario specific constraints. A two-step solution approach minimizes the weighted sum of deviations of actual surgical start times from their planned start times.

■ SD65

Mezzanine - 100F

Complex Systems and Networks

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Jonathan Ozik, Argonne National Laboratory, 9700 S Cass Ave., DIS, Bldg. 221, Argonne, IL, 60439, United States of America, jozik@anl.gov

1 - Deriving Infectious Disease Contact Networks through Agent-based Simulation

Charles Macal, Senior Systems Engineer, Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221 - DIS, Argonne, IL, 60439, United States of America, macal@anl.gov

An agent-based activity simulation is used to derive an infectious disease contact network. A synthetic population of individuals and households for Chicago is developed based on census and survey data. Agents are matched to activity profiles relevant to disease transmission, specifically community-associated Methicillin-resistant Staphylococcus aureus (CA-MRSA). The presentation describes the development of the network and analysis of its topological properties.

2 - Noncooperatively Optimized Tolerance: Decentralized Strategic Optimization in Complex Systems

Yevgeniy Vorobeychik, Vanderbilt University, 2201 West End Ave., Nashville, TN, United States of America, eug.vorobey@gmail.com

We introduce noncooperatively optimized tolerance (NOT), a generalization of highly optimized tolerance (HOT) that involves strategic (game theoretic) interactions between parties in a complex system. We find that there is a "sweet" spot of an intermediate number of players, where the system is both robust *and* resilient to changes in the environment.

3 - Competitive Food Supply Chain Networks with Application to Fresh Produce

Min Yu, University of Portland, 5000 N Willamette Blvd., Portland, OR, 97203, United States of America, yu@up.edu, Anna Nagurney

We developed a network-based food supply chain model under oligopolistic competition and perishability. We captured the food deterioration along the entire supply chain, as well as the disposal of the spoiled food products. We allowed for product differentiation due to product freshness and food safety concerns, as well as the evaluation of alternative technologies. A case study focused on the cantaloupe market was investigated, in which we analyzed the impact of a foodborne disease outbreak.

■ SD66

Mezzanine - 100G

eBusiness Models, Business Strategy and Innovation

Sponsor: Information Systems

Sponsored Session

Chair: Harpreet Singh, University of Texas-Dallas, Richardson, TX, United States of America, harpreet@utdallas.edu

1 - Participation in Open Knowledge Communities and Career Development: An Empirical Analysis

Peng Huang, Robert H. Smith School of Business, University of Maryland, University of Maryland, College Park, MD, 20742, United States of America, phuang1@rhsmith.umd.edu, Zhongju Zhang

We investigate the relationship between participation in Internet-enabled knowledge communities and a major career event: job hopping. We find that while contributing behavior leads to a higher likelihood of job switch, greater amount of learning is associated with higher probability of staying with the current firm. In addition, we find that the social capital one builds through the interaction with others on the knowledge network moderates these relationships.

2 - Can Daily-deal E-coupon Sites Survive? An Empirical Investigation of Key Factors

Gang Wang, Phd Student, University of Connecticut, 2100 Hillside road, Storrs, CT, 06269, United States of America, gang.wang@business.uconn.edu, Bill Ross, Xue Bai, James Marsden

While daily-deal websites appear to be gaining prominence, analysts and academic researchers continue to question their long term viability. To date, little analysis has focused on the existing business model or on identifying a business model that would enable long term viability. In our empirical analysis, we investigated key relationships that must be taken into account in developing a business model of the industry. The study offers a variety of managerial insights for industry members.

3 - The DeMOOCratization of Online Education: An Empirical Study of the Efficacy of Online Courses

Aravinda Garimella, PhD Student, University of Washington, 400 NE 45th Street, Seattle, Wa, 98105, United States of America, aravinda.garimella@gmail.com, Yong Tan, Ming Fan

Massive open online courses (MOOCs) are changing the landscape of education as we know it. We study the implications of the large scale and heterogeneity of the student population in MOOCs on learning dynamics and empirically investigate the efficacy of MOOCs as a pedagogical tool. We study student behavior over time and inquire whether the social nature of these platforms turn them into symbiotic platforms where students learn not only from the instructor, but also from each other.

4 - Effect of Inaccurate Inventory Information Sharing of a Drop-shipper with an Online Retailer

Taesu Cheong, Assistant Professor, National University of Singapore, ISE Department, 1 Engineering Drive 2, Singapore, 117576, Singapore, isects@nus.edu.sg, Mark Goh, Sang Hwa Song

We investigate the impact of information discrepancy between a drop-shipper and an online retailer on a drop-shipping supply chain performance, based on a newsvendor framework. Information mismatches between two parties contribute to the failure of complete order fulfillment. We assess the effects of ignoring information discrepancy on the supply chain performance through numerical experiments.

■ SD67

Mezzanine - 100H

DAS Practice Award Finalists

Sponsor: Decision Analysis

Sponsored Session

Chair: Frank Koch, Koch Decision Consulting, 2510 Cleveland St., Eugene, OR, 97405, United States of America, frank@kochdecisions.com

1 - To Screen or Not To Screen: A Decision Analysis for Genetic Screening for Lynch Syndrome

Tuan Dinh, VP Analytics and Modeling, Archimedes Inc, 123 Mission St., 11th Floor, San Francisco, CA, 94105, United States of America, tuan.dinh@archimedesmodel.com

Lynch syndrome (LS) is a genetically inherited predisposition to multiple types of cancer. Current guidelines recommend that a diagnostic workup for LS begin when an individual already presents with cancer. We developed a decision analysis to determine under which conditions offering genetic testing to individuals at high risk of carrying LS mutations prior to cancer development will lead to improved health outcomes in a cost effective way.

2 - Evaluation, Play Entry Strategy, and Materiality in Unconventional Gas & Liquids-Rich Opportunities

William Haskett, Senior Principal - Energy Strategy, Decision Strategies Inc., 10333 Richmond St., Suite 350, Houston, TX, 77005, United States of America, bhaskett@decisionstrategies.com

Source rock plays revolutionized the Energy industry leading to new decision challenges and methods. Targets are a "family" of wells; a distribution of distributions. A novel method is shown to carry cell-based uncertainty across the play, which allows pilot optimization, decision thresholds, Confidence, and valuation. It has been implemented successfully world-wide. These concepts are applied to create and implement a play entry strategy, materiality, and create material competitive advantage.

3 - Designing a Media-specific Balanced Scorecard by Applying Value-focused Thinking

Johannes Siebert, University of Bayreuth, Bayreuth, Germany, Johannes.Siebert@uni-bayreuth.de, Reinhard Kunz, Joschka Mütterlein

Since its introduction by Kaplan and Norton in 1992 the Balanced Scorecard (BSC) has started a remarkable triumphal march. It is surprising that most often the process of creating BSCs is methodological poorly exercised and established techniques of decision analysis are not considered. We introduce a systematic, consistent and efficient approach of creating a BSC using Value-focused Thinking. In a case study, we illustrate the procedure and create a highly individualized media-specific BSC.

■ SD68

Mezzanine - 100I

Advances in Decision Analysis: From Multicriteria to Value of Information

Sponsor: Decision Analysis

Sponsored Session

Chair: Emanuele Borgonovo, Professor, Bocconi University, Via Roentgen 1, Milan, Italy, emanuele.borgonovo@unibocconi.it

1 - What You May Not Know About Information Value

Gordon Hazen, Professor, Northwestern University, IEMS Department, McCormick School of Engineering, Evanston, IL, 60208-3119, United States of America, gbh305@northwestern.edu

Information value has a long history in decision analysis and related fields. We summarize lesser known properties of perfect and sample information value, and examine the relation to Shannon information, as well as conventional and unconventional treatment of information value under expected utility. We also consider information value as a sensitivity analysis tool, and introduce the concept of information density.

2 - Expected Utility and Narrow Bracketing

Manuel Baucells, Professor, Rand Corporation, 1776 Main St., Santa Monica, CA, 90407, United States of America, mbaucells@gmail.com

Subjects have a strong tendency to engage in narrow bracketing. In the context of prescriptive utility theory, we examine utility functions that are robust to narrow bracketing: Even when solving each period's problem in isolation we still produce the optimal solution to the multi-period problem. We characterize the class of utility functions that are robust to narrow bracketing in three decision environments, namely, stationary, probabilistically independent, and probabilistically dependent.

3 - Elicitation of Multiattribute Utility Functions through High Dimensional Model Representation

Alessandra Cillo, Bocconi University, Via Roentgen 1, 20136 Milan, Italy, alessandra.cillo@unibocconi.it, Francesca Beccacece, Emanuele Borgonovo, Greg Buzzard, Stanley Zionts

Our paper exploits the connection between multiattribute utility theory and high dimensional model representation theory for investigating the properties of multiattribute utility functions without stating any a-priori assumption on an individuals' preference structure. We test the method via an experiment in a riskless context in which subjects are asked to evaluate mobile phone packages that differ on three attributes. We obtain insights on monotonicity and additivity.

4 - Modeling Ambiguity Attitudes in Decision Analysis

Emanuele Borgonovo, Professor, Bocconi University, Via Roentgen 1, Milan, Italy, emanuele.borgonovo@unibocconi.it, Massimo Marinacci

In several decision analysis problems, state of knowledge does not allow decision-makers to assign a certain value to the involved probabilities. Experimental evidence has shown that this uncertainty (ambiguity) is accompanied by behavioral consequences. We explore the explicit modelling of these attitudes using minimax, subjective expected utility and smooth ambiguity functionals in combination with the traditional decision-analysis representation of choice problems.

■ SD69

Mezzanine - 100J

Decision Analysis I: Risk Mitigation

Contributed Session

Chair: Shweta Agarwal, PhD Student (Decision Science), London School of Economics, Houghton Street, London, WC2A2AE, United Kingdom, s.agarwal@lse.ac.uk

1 - Trade-off Consistency Foundation and Risk Premium Measurement of Regret Theory

Enrico Diecidue, Associate Professor, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Enrico.Diecidue@insead.edu, Jeeva Somasundaram

In this paper, we propose a new behavioral foundation for Regret Theory (RT) based on trade off consistency. The axioms used are intuitive and empirically testable. We also develop a trade off consistency method to measure components of risk premium (regret and resolution premium), of a regret averse (or seeking) decision maker. This allows RT to be used for practical applications.

2 - Regret Theory and Multivariate Stochastic Orders

Chin Hon Tan, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, isetch@nus.edu.sg, Joseph Hartman

It is well-known that stochastic dominance alone is insufficient for ensuring preferences when individuals experience regret. In this paper, we obtain a set of conditions that are necessary and sufficient for unanimous preferences in regret theory using known results in multivariate stochastic orders. We illustrate how our proposed conditions can be used in problems involving discrete and continuous prospects through two examples.

3 - Skewness Preference and Behavior Toward Risk

Mark Schneider, UConn Business School, 2100 Hillside Road, Unit 1041, Storrs, 06269, United States of America, mark.schneider@business.uconn.edu, Robert Day, Robert Garfinkel

A model of decision making under risk is explored in which a decision maker is risk-averse toward negative skewness and risk-seeking toward positive skewness. We show that the model explains important observed violations of expected utility theory such as the Allais paradoxes and the fourfold pattern of risk attitudes. We establish the formal relationship between skewness preference and these paradoxes, and the relationship between the proposed model and cumulative prospect theory.

4 - Product Investment Timing under Exogenous Policy Uncertainty

Xiamin Yan, School of Management, Xi'an Jiaotong University, Xi'an 710049, China, PO Box 2268, Xi'an Jiaotong University, Xi'an, China, xiamin_yan@126.com, Yan-jun Qian, Jun Lin

Exogenous policy includes two kinds of possible situations as advantageous and disadvantageous. Firms are assumed to invest in one of two opportunities as early (uncertainty is high) and late (uncertainty has been resolved). By modeling and analysis, this paper gives conditions of early investment, late investment and no investment, and finds that the possibility of early investment is increased by the expected advantageous and disadvantageous demand. Considering some investment opportunity separately, we find that investment income is increased by the total expected demand, expected advantageous demand and uncertainty, the expected disadvantageous demand has positive relationship with early investment income, but has no impact on late investment income.

5 - A Quantitative Model for Measuring the Value of Operational Risk Mitigations

Shweta Agarwal, PhD Student (Decision Science), London School of Economics, Houghton Street, London, WC2A2AE, United Kingdom, s.agarwal@lse.ac.uk, Gilberto Montibeller

Extant methods to assess Operational Risks, such as the Loss distribution approach (LDA), often do not explicitly consider the effect of mitigations on the loss distribution. This paper discusses a quantitative Probability Revision Matrix method to model managerial interventions that affect one or more uncertainties related to a loss event. We illustrate how this approach can be used in the LDA framework to calculate the value of mitigation using a real-world case study on staff strikes.

■ SD70

Mezzanine -101A

AAS Dissertation Prize Finalists

Sponsor: Aviation Applications

Sponsored Session

Chair: Thomas Vossen, University of Colorado at Boulder, 995 Regent Dr, Boulder, CO, 80309, United States of America, Vossen@Colorado.EDU

1 - AAS Dissertation Prize Finalists

Thomas Vossen, University of Colorado at Boulder, 995 Regent Dr, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

This session will feature finalists for the Aviation Applications dissertation prize. The Aviation Applications dissertation prize winner will be announced in the business meeting at INFORMS.

2 - Stochastic Control of Runway Configurations and Service Rates at JFK Airport

Alexandre Jacquillat, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-234a, Cambridge, MA, 02139, United States of America, alexjacq@mit.edu

This paper optimizes the tactical utilization of airport capacity in the face of queue stochasticity and operating stochasticity. We minimize congestion costs by jointly controlling runway configurations and arrival and departure service rates, as a function of flight schedules, capacity estimates, observed congestion and operating conditions. Stochastic queue dynamics are combined to a dynamic programming framework. The combination of exact and approximate algorithms enables on-line implementation. The application at JFK suggests potential congestion costs savings of 15% to 20%.

3 - Itinerary-based Control with Nesting and Upsell

Bill Pun, Senior Operations Research Consultant, Sabre Holdings, 3601 Grapevine Mills Pkwy, Grapevine, TX, 76951, United States of America, Bill.Pun@sabre.com

We formulate a stochastic optimization problem that captures allocation nesting and customer upsell at the itinerary level. Approximate dynamic programming is applied to approximate the objective function by piecewise linear functions. The resulting allocation policy is tested on a real airline network and benchmarked against the randomized linear programming bid-price policy under various demand settings.

4 - Mitigation of Airspace Congestion Impact on Airline Networks

Bo Vaaban, Technical University of Denmark, Kgs. Lyngby, Denmark, bova@dtu.dk

In recent years European airspace has become increasingly congested and airlines can now observe that en-route capacity constraints is the fastest growing source of flight delays. In 2010 this source of delay accounted for 19% of all flight delays in Europe and has been increasing with an average yearly rate of 17% from 2005 to 2010. This paper suggests and evaluates an approach to how disruption management can be combined with flight planning and ATC information in order to create more proactive handling of the kind of disruptions, which are caused by congested airspace. The approach is evaluated using data from a medium size European carrier and estimates a lower bound saving of several million USD.

5 - An Integrated Framework for Freight Forwarders: Air Cargo Pickup and Delivery Problem with Alternative Access Airports

Farshid Azadian, Assistant Professor, Embry Riddle Aeronautical University, 600 S Clyde Morris Blvd, COB, Room 222, Daytona Beach, FL, 32114, United States of America, azadianf@erau.edu

Continuous growth in air cargo deliveries and increasing competition are necessitating freight forwarders to develop innovative solutions to improve the delivery performance and the efficiency of air cargo logistics. Increased availability of historical and real-time flight information enables freight forwarders to avoid congestion and reduce costs by effectively routing their time-sensitive shipments on both the road and the air transport networks. While the static and dynamic routing on the road networks has been studied extensively, the routing of air cargo on the multimodal air-road networks is unexplored and presents unique challenges as well as opportunities. We address this gap by considering multiple air cargo shipments from geographically dispersed customer locations and investigate the freight forwarder's operational implementation of alternative access airport policy (AAAP) in a multi-airport region (MAR). Given a set of heterogeneous customers, the forwarder's problem is to simultaneously plan for air cargo flight itineraries and the pickup and delivery of customer loads to the airport(s). This problem generalizes the well-known pickup and delivery problems with time and destination dependent delivery costs. An efficient solution method based on successive subproblem solving is developed. The results of computational experiments and a practical case study demonstrate the merits of the AAAP and show that the proposed methodology is very efficient and effective.

■ SD72

Mezzanine -101C

EZ Publish

Cluster: INFORMS Communities

Invited Session

Chair: Shirley Mohr, INFORMS, 5521 Research Park Drive Suite 200, Catonsville, MD, 21228, United States of America, Shirley.mohr@informs.org

1 - Learn about 'EZ' Website Management Tools and Hosting for INFORMS Communities

Shirley Mohr, INFORMS, 5521 Research Park Drive Suite 200, Catonsville, MD, 21228, United States of America, Shirley.mohr@informs.org

This session is for INFORMS Community officers and webmasters and introduces EZ Publish, an easy but powerful web management tool for quickly creating and updating web sites without the need for web design experience or software. All you need is an internet connection and a login and you can get started. Any INFORMS Community or Subdivision that wishes to utilize a ready-made INFORMS template and intuitive tools to create and maintain their website should attend. Special features include blogs, forums, password-protected areas, real-time twitter feeds, and analytics reports about your site.

Monday, 8:00am - 9:30am

■ MA01

Level 2 - Room 200A

Optimization, Spatial Analysis and GIS I

Cluster: Optimization, Spatial Analysis and GIS

Invited Session

Chair: Alan Murray, Arizona State University, Tempe, AZ, United States of America, atmurray@asu.edu

1 - q-Ad-hoc Hub Assignment Due to Hub Outages

Hyun Kim, Assistant Professor, University of Tennessee, Department of Geography, 1000 Philip Fulmer Way, Knoxville, TN, 37996, United States of America, hkim56@utk.edu, Megan Ryerson

If an outage occurs at a hub, transferring goods will be impeded unnecessarily. A recovery strategy could be the utilization of alternative hubs in an ad-hoc manner; this is, in essence, reverse network interdiction. We propose the q-Ad-hoc hub assignment model to re-organize the spatial structure of a disrupted hub network with unaffected hubs serving as ad-hoc replacement hubs and the establishment of alternative routes connecting supply and demand nodes with the ad-hoc ports.

2 - Non-Partisan Political Redistricting

Hayri Onal, Professor, University of Illinois at Urbana-Champaign, 1301 W. Gregory Dr., 305 Mumford Hall, Urbana, IL, 61801, United States of America, h-onal@illinois.edu, Kevin Patrick

A linear integer programming model is developed to configure non-partisan political districts with population equality, compactness, contiguity, and community integrity considerations. An application to redistricting in Illinois will be presented using the 2000 and 2010 census data where approximately 3000 census tracts are assumed as spatial units.

3 - Shadow Prices in Territory Division
John Carlsson, University of Minnesota, 111 Church St., SE, Office 130C, Minneapolis, MN, 55455, United States of America, jgc@umn.edu

We consider a geographic optimization problem in which we are given a geographic region, a probability density function defined on that region, and a collection of utility density functions defined on the region. Our objective is to divide the region into sub-regions so as to "balance" the overall utilities on the regions. Using a simple complementary slackness argument, we derive closed-form expressions for the optimal boundaries between sub-regions.

4 - A Bounding based Solution Approach for the Continuous Arc Covering Problem
Ran Wei, Arizona State University, P.O.Box 875302, Tempe, AZ, 85287, United States of America, rwei5@asu.edu, Alan Murray

Siting facilities to serve continuous arc demand is common in many planning contexts. While this amounts to a continuous location problem by nature, various discretizations are generally relied upon to solve such problems. The result is potential for representation errors that negatively impact analysis and decision making. This paper develops a solution approach for the continuous arc covering problem that theoretically eliminates representation errors.

■ MA02

Level 2 - Room 200B

Topics in Computational Integer Programming

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Alexandra Newman, Associate Professor, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Improving Performance of Linear and Mixed Integer Programs
Alexandra Newman, Associate Professor, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, anewman@mines.edu

Even with state-of-the-art hardware and software, linear and mixed integer programs can require a significant amount of computing time to reach an optimal or near-optimal solution. Careful modeling constructs and specific use of commercial algorithms can vastly improve performance. In this talk, we present examples of correct use of modeling languages, good model formulation, and algorithmic selection and parameter tuning that enhance optimization model performance.

2 - Solving Large, Unstructured Problems with Benders Decomposition
Tony Tarvin, PhD Candidate, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, dtarvin@mymail.mines.edu, Alexandra Newman, Kevin Wood

Benders decomposition (BD) is typically applied to solve linear programs (LPs) or mixed-integer programs (MIPs) with special structure. We show that BD can help solve large, unstructured LPs, MIPs and even integer programs (IPs). Computational results show order-of-magnitude speedups on a variety of problems, including instances from anomaly detection, crew scheduling, mining, and multi-dimensional packing.

■ MA03

Level 2 - Room 200C

Nonconvex Quadratic Programming: Theory and Applications

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Sam Burer, Professor, University of Iowa, S346 Pappajohn Business Building, Iowa City, United States of America, samuel-burer@uiowa.edu

1 - Solving Two Inverse Optimization Problems via Quadratic Branch-and-Bound
Guanglin Xu, PhD Student, The University of Iowa, 108 Hawkeye Court, Iowa City, IA, 52246, United States of America, guanglin-xu@uiowa.edu, Alexandre Belloni, Sam Burer

We investigate two inverse optimization problems: (i) a particular partial inverse problem arising in instrumental variable quantile regression; and (ii) an inverse optimal value problem studied by Ahmed and Guan. We convert both to mathematical programs with complementary constraints, which are generally NP-hard. We then introduce a single branch-and-bound algorithm for solving (i) and (ii) globally. Finally, we present computational results comparing our algorithm with existing global solvers.

2 - The Trust Region Subproblem with Non-Intersecting Linear Constraints
Sam Burer, Professor, University of Iowa, S346 Pappajohn Business Building, Iowa City, United States of America, samuel-burer@uiowa.edu, Boshi Yang

We study an extended trust region subproblem in which the trust region intersects the unit ball with m linear inequality constraints. We show that a certain convex relaxation exhibits no gap as long as the linear constraints are non-intersecting in the unit ball.

3 - Cutting-plane Representations of Convex Functions Over Nonconvex Sets
Daniel Bienstock, Columbia University, 500 W 120th St., New York, United States of America, dano@columbia.edu, Alexander Michalka

We consider sets of the form conv(S), where S = {(x, q) : q >= Q(x), x in F} where Q is an arbitrary convex function and F is an arbitrary closed set in R^n. When Q is differentiable (and in other cases) we show that conv(S) can be obtained by lifting (in the mixed-integer programming sense) the gradient approximation to Q(x) on points of the boundary of F. We describe some cases where this leads to polynomial-time separation and present computational experiments.

■ MA04

Level 2 - Room 200D

MIP Models and Methods

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Jean-Philippe Richard, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, richard@ise.ufl.edu

1 - Mathematical Programming for Regression Subset Selection
Young Woong Park, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, ywpark@u.northwestern.edu, Diego Klabjan

Subset selection in multiple linear regressions is to choose a subset of candidate explanatory variables that tradeoff error and the number of variables selected. We built mathematical programs for subset selection and compare the performance of an LP-based branch-and-bound algorithm with valid inequalities to known heuristics. Our model is also applicable to the case with more candidate explanatory variables than observations where we present a heuristic based on the model.

2 - Linear Programming Insights into Solvable Cases of the Quadratic Assignment Problem
Lucas Waddell, Clemson University, 101 Sikes Ave., Clemson, SC, 29634, United States of America, lwaddel@clemson.edu, Warren Adams

The quadratic assignment problem is a well-known, NP-hard discrete optimization program that has been extensively studied for over 50 years. We examine three recent, readily-solvable special cases and show how they can be explained in terms of the dual region to the continuous relaxation of the level-1 RLT representation. These explanations allow for simplifications and/or generalizations of the conditions defining the special cases.

3 - Valid Inequalities for the 1-Restricted Simple 2-Matching Polytope
Yanjun Li, Associate Professor of Management, Purdue University, 403 West State Street, West Lafayette, IN, 47907, United States of America, li14@purdue.edu, David Hartvigsen

A simple 2-matching in a simple undirected graph is a subgraph with node degree 1 or 2. A simple 2-matching is called 1-restricted if each of its connected components has at least two edges. We introduce two classes of valid inequalities for the 1-restricted simple 2-matching polytope: r-1 and r-2 blossom inequalities. We characterize the facet inducing r-1 and r-2 blossom inequalities on a class of 1-restricted blossoms, and characterize the facet inducing r-2 blossom inequalities with depth 2.

■ MA05

Level 2 - Room 200E

Stochastic and Probabilistic Network Optimization

Sponsor: Optimization/Networks

Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu

1 - Integer and Constraint Programming Methods for a Dynamic Network Interdiction Problem

Thomas Sharkey, Assistant Professor, Rensselaer Polytechnic Institute, 110 8th St. CII, Suite 5015, Troy, NY, 12180, United States of America, sharkt@rpi.edu, Chase Rainwater

We consider a dynamic network interdiction problem where law enforcement resources must be scheduled to remove criminals from a drug trafficking network. The objective of this problem is to minimize the cumulative amount of flow through the network over a finite horizon. We propose a hybrid integer and constraint programming method that takes advantage of the structure of the interdiction and scheduling decisions. Our method is tested on realistic instances based on a small city.

2 - Optimizing Quality of Service Levels in Probabilistic Network Capacity Design Problems

Zhihao Chen, University of Michigan, Ann Arbor, MI, 48109, United States of America, czhihao@umich.edu, Siqian Shen

We formulate chance-constrained models to optimize probabilistic network design problems under uncertain demand with the aim of differentiating quality of service, which determines the priority of customers versus commodities. The problem determines the link capacities while ensuring a certain level of demand satisfaction through the flows. We reformulate the models as MIPs, compare results with models penalizing low satisfaction, and derive polynomial-time algorithms for special cases.

3 - Bounds on Survival Probability of Random Walk with Memory on Fortified Arcs of a Directed Network

Sadie Thomas, Graduate Student, University of Florida, 302B Weil Hall, PO Box 116595, Gainesville, FL, 32611-6595, United States of America, sadiethomas@ufl.edu, J. Cole Smith

A random walk begins at a node of a directed network and seeks the destination node. The walk can fail at each arc traversal with a given probability, resulting in the failure of the walk. Once an arc is successfully crossed, the walk cannot fail on it if crossed again. Additionally, each arc can be fortified to ensure an increased probability of successful traversal. The total cost of arc fortification is limited. We develop bounds for the probability of such a random walk's success.

4 - Interdicting Probabilistic Shortest Paths: Models, Algorithms, and Applications

Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu

We study Probabilistic Network Interdiction in computer networks and traffic routing. We consider two shortest-path problems with objectives of maximizing the probability that a chosen path is shorter than a critical length, and minimizing the path length attained with a fixed probability, respectively. We provide exact algorithms involving computation of k-shortest paths, and also develop heuristics and a column generation approach to approximate the results.

■ MA06

Level 2 - Room 200F

Robust Optimization in Radiation Therapy

Sponsor: Optimization/Linear Programming and Complementarity

Sponsored Session

Chair: Hamid R Ghaffari, Senior System Engineer, Innovative Scheduling Inc., 2153 SE Hawthorne Rd., Ganiesville, FL, 32641, United States of America, hamid.ghaffari@innovativescheduling.com

1 - MPI-based Parallel Genetic Algorithms for Radiation Treatment Planning

Gino Lim, Associate Professor, University of Houston, Department of Industrial Engineering, E206 Engineering Building 2, Houston, TX, 77204-4008, United States of America, ginolim@uh.edu, Likang Ma

Beam Angle Optimization (BAO) is a very large-scale MIP problem, which is computationally intractable in a clinical setting. To overcome this difficulty, we present two MPI-based parallel genetic algorithms with a Master-Worker framework. We present the results of our approach that show a clear improvement in solution quality, CPU time, and resource utilization.

2 - Effectiveness of Robust Optimization in IMPT for Head and Neck Cancer

Wei Liu, Assistant Professor, The University of Texas MD Anderson Cancer Center, 1515 Holcombe Blvd. Y2.5605, Unit 0094, Houston, TX, 77030, United States of America, franklin_liu1019@hotmail.com, Xiaorong Zhu, Steven Frank, Radhe Mohan

IMPT is highly sensitive to uncertainties in beam range and patient setup. In the worst case and nominal scenarios, robustly optimized plans showed better target coverage, improved dose homogeneity, and lower or equivalent dose to organs at risk (OARs). Robust optimization provided significantly more robust dose distributions to targets and organs than conventional optimization in H&N using IMPT. Reduction of PTV and planning directly based on CTV provided better or equivalent OAR sparing.

3 - Managing Uncertainty in Structure Functionality using Robust Radiation Therapy Treatment Planning

Victor Wu, PhD Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, vwwu@umich.edu, Martha Matuszak, Marina Epelman, Mary Feng, Troy Long, Edwin Romeijn

X-ray computed tomography (CT) maps patient geometry in radiation therapy treatment planning. Dynamic contrast enhanced magnetic resonance imaging (DCE-MRI) provides perfusion maps that represent tissue function. Registering CT and MRI scans results in potentially uncertain perfusion data. We propose a robust optimization model that provides plans insensitive to this uncertainty. We use liver cancer cases to compare treatment plans obtained with and without using functionality information.

4 - A Robust Direct Aperture Optimization Approach to Breast Cancer Radiation Therapy

Houra Mahmoudzadeh, University of Toronto, 5 Kings College Rd., Toronto, Canada, houra@mie.utoronto.ca, Timothy Chan, Thomas Purdie

We extend a previously developed robust optimization method to obtain a direct aperture optimization (DAO) approach for radiation therapy of breast cancer. The DAO model is a mixed integer linear program that takes into account breathing uncertainty and contains constraints on the segment shapes and weights in order to ensure deliverability. We propose a fast solution approach to solve large-scale mixed integer problems of this nature. Results are compared with those of clinical methods.

■ MA07

Level 2 - Room 200G

Robust Optimization and Its Applications I

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu

1 - Process Flexibility: Analytic Bound on the Performance of K-chain

Jiawei Zhang, Stern School of Business - NYU, 44 West 4th St., New York, NY, 10012, United States of America, jzhang@stern.nyu.edu, Xuan Wang

The effectiveness of the long chain has been validated by empirical and theoretical analysis for specific demand distributions. We present an analytic bound on the ratio of the expected sales of the long chain relative to that of full flexibility. Our bound uses only mean and variance of the random demand, but compares very well with the case with known distributions. This suggests the robustness of long chain's performance under different distributions. We obtain similar bounds for k-chain.

2 - Robust Optimization in Data Rich Environments

Vishal Gupta, Massachusetts Institute of Technology, ORC, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, vgupta1@mit.edu, Dimitris Bertsimas, Nathan Kallus

The last decade witnessed an explosion in data availability. Motivated by this data rich paradigm, we propose a novel schema to utilize data to design uncertainty sets for robust optimization by using hypothesis tests. Models built with our new sets are computationally tractable, and their solutions enjoy a finite-sample probabilistic guarantee. Through applications in portfolio management and queueing, we show that our data-driven sets outperform conventional sets whenever data is available.

3 - Pareto Efficiency in Robust Optimization
Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu, Nikos Trichakis

We formalize the concept of Pareto efficiency in the context of the robust optimization (RO) methodology.We characterize Pareto robustly optimal (PRO) solutions,and extend the RO framework by proposing methods to verify Pareto optimality and generate PRO solutions.Our approach requires solving problems that are of the same complexity as the nominal RO problems,and numerical experiments demonstrate the significant potential upside of PRO solutions compared with classical RO solutions.

■ MA08

Level 2 - Room 200H

Computational Linear and Integer Programming I

Sponsor: Computing Society

Sponsored Session

Chair: Yan Xu, Senior Manager, SAS Institute Inc., 100 SAS Campus Dr, Cary, United States of America, Yan.Xu@sas.com

1 - Recent Improvements in IBM ILOG CPLEX Optimization Studio
Tobias Achterberg, CPLEX Optimization Developer, IBM, Zuse Institute Berlin, Takustr. 7, Berlin, 14195, Germany, achterberg@de.ibm.com

We present new features that have been added to CPLEX and give detailed benchmarking results that demonstrate the performance improvements in recent CPLEX versions.

2 - Recent Improvements in SAS/OR Optimization Solvers
Imre Pòlik, SAS Institute, 100 SAS Campus Dr, Cary, NC, 27513, United States of America, imre@polik.net, Menal Güzelsoy, Philipp Christophel, Yan Xu, Amar Narisetty

We will present the latest improvements in the SAS/OR linear and mixed-integer optimization solvers including symmetry-based techniques and presolver improvements.

3 - Disconnected or Almost Disconnected MIP
Zonghao Gu, Gurobi Optimization Inc., 3733-1 Westheimer Rd., #1001, Houston, TX, 77027, United States of America, gu@gurobi.com

Some MIPs are disconnected originally or become disconnected after presolve reductions or after fixings based on reduced costs. To solve a MIP to optimality, we can solve all disconnected pieces one by one. This can be much faster than solving the MIP as a whole. However, optimality gap considerations can cause complexities. We will talk about our approach to address the complexities and several implementation issues. We will also talk about "almost disconnected" MIPs.

4 - Recent Advances in Xpress Pre-solve
Michael Perregaard, Xpresss Optimization, FICO, FICO House, International Square, Starley Way, Birmingham, B37 7GN, United Kingdom, MichaelPerregaard@fico.com

The ability to reduce and tighten MIP problems significantly by the application of simple rules often makes the differences between a solvable and an unsolved problem. We will here present some of the recent presolve techniques applied by Xpress.

■ MA09

Level 2 - Room 200I

Innovative Applications in Analytics Award I

Sponsor: Analytics Section

Sponsored Session

Chair: Pooja Dewan, General Director, Burlington Northern Santa Fe Corporation, 2400 Western Center, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

1 - Innovative Applications in Analytics Award
Pooja Dewan, General Director, Burlington Northern Santa Fe Corporation, 2400 Western Center, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

The purpose of the third annual Innovative Applications in Analytics Award is to recognize creative and unique developments, applications or combinations of analytical techniques used in practice. The prize promotes the awareness of the value of analytics techniques in unusual applications, or in creative combination to provide unique insights and/or business value. These three sessions in the INFORMS annual meeting will be focused on having the 9 Semi-finalists of the award present their work to a panel of judges. At the end of the sessions, the judges will deliberate and determine the 3 Finalists that will present in the Spring INFORMS of 2014.

2 - Imposing Domain Expertise on Algorithmic Learning to Construct Highly Predictive and Palatable Scorecards
Gerald Fahner, FICO

Credit scoring systems must be easy to explain and conform to certain legal/operational constraints. Algorithmic learners such as Tree Ensemble Models (TEMs) often outperform traditional scorecards on predictive grounds, but may not satisfy all the constraints. Our novel approach productively exploits valuable information found by TEMs to inform the construction of compliant scorecard systems with superior predictive power as compared to traditional scorecard development approaches.

3 - Analyzing Social Media Data Having Discontinuous Underlying Dynamics
Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford MA, United States of America, lservi@mitre.org

This talk develops a real time algorithm which identifies times of emotional discontinuity as reflected in social media. The talk formulates the optimization problem to solve, develops an algorithm to solve it using dynamic programming, and illustrates the new method by analyzing mood shifts reflected in 380,000 Twitter messages related to one of the most popular soccer teams, Manchester United, during their 2011-12 season.

4 - Development of Repeat Offender Model for Colorado Springs Police Department
Aaron Burns, United States Air Force Academy, United States of America, Rebekah McKenna, Zachary Smith, Zebulon Hanley

The idea of Intelligence Led Policing grows in popularity throughout the country. A repeat offender model could help prioritize policing activities. This project created a model incorporating all types of individual offenses to determine the propensity to commit repeated crimes and prioritizes results with each crime's weighted societal impact factor.

■ MA10

Level 2 - Room 200J

Panel Discussion: OR, Analytics and the Academic: The Path Forward

Sponsor: Analytics Section

Sponsored Session

Chair: Terry Harrison, Penn State University, 459 Business Building, Univeristy Park, United States of America, tharrison@psu.edu

Co-Chair: Nicholas G. Hall, Ohio State University, 2100 Neil Avenue, 658 Fisher Hall, Columbus, OH, 43210-1144, United States of America, hall_33@fisher.osu.edu

1 - OR, Analytics and the Academic: The Path Forward
Moderator: Terry Harrison, Penn State University, 459 Business Building, Univeristy Park, United States of America, tharrison@psu.edu, Panelists: Nicholas G. Hall, Barrett Thomas

This panel discussion focuses on the value delivered by the analytics movement to the academic membership of INFORMS. Opportunities to be discussed include new academic programs, new research problems, funding of research, collaboration with industry, and enhancement of classroom content.

■ MA11

Level 2 - Room 201A

An Interactive Panel/Audience Discussion: Grant Writing for New Faculty

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Erick Moreno-Centeno, Assistant Professor, Texas A&M University, 4034 ETB, College Station, TX, 77843, United States of America, e.moreno@tamu.edu

1 - An Interactive Panel/Audience Discussion: Grant Writing for New Faculty

Moderator: Erick Moreno-Centeno, Assistant Professor, Texas A&M University, 4034 ETB, College Station, TX, 77843, United States of America, e.moreno@tamu.edu, Panelists: Sheldon Jacobson, Simge Küçükyavuz, Edwin Romeijn, Sergiy Butenko

In this interactive panel, we will discuss successful strategies for writing grants. The panel comprises NSF program directors, and successful grant-writing/winning faculty (both at NSF and other agencies). Panel members will share strategies for writing grants including choosing the appropriate agency, preparing for and writing a grant. A large part of the panel will be an interactive discussion with the audience.

■ MA12

Level 2 - Room 201B

SpORts - Analysis of Data and Strategies I

Sponsor: SpORts

Sponsored Session

Chair: James Cochran, Louisiana Tech University, Ruston, LA, United States of America, jcochran@latech.edu

1 - A Puck in the Net Beats Four Men in the Box

Ed Kaplan, Yale School of Management, New Haven, CT, 06520, United States of America, edward.kaplan@yale.edu, Kevin Mongeon, John Ryan

The classic Poisson model of hockey provides a simple method for calculating the probability of a team winning a hockey game given the score differential and time remaining to play. We extend this model to include the effect of penalties by expanding the model state space to include manpower differential in addition to score differential and remaining time. Given data from the 2008-2011 National Hockey League seasons (a total of 4,920 games), we derive and report the associated state-space model. The modeling shows that, for any fixed duration of time left in the game, the probability that a team leading by g goals playing two men down wins is higher than the probability that a team leading by g-1 goals playing two men up wins, explaining the title of the paper.

2 - Strategic Time Wasting in Football

Nils Rudi, INSEAD, 1 Ayer Rajah Ave., Singapore, Singapore, nils.rudi@insead.edu, Henrich R. Greve, Anup Walvekar

We examine the sources of time wasting in professional football (soccer). Although purposely delaying the game is illegal, it is a potential strategic behavior that players in specific positions (e.g., goalkeeper) or entire teams may engage in when it increases the chances of a favorable match outcome. We test heuristic rules for when players might waste time in re-starting the play after a stoppage, along with analytical rules based on the estimated arrival rates of goals for both teams. We find evidence of systematic and strategic time wasting across many player behaviors. The evidence supports a reconsideration of the current time-keeping rules in the game of football.

3 - Can Pythagoras Predict the Winners of the English Premier and Spanish Football Leagues?

James Cochran, Louisiana Tech University, Ruston, LA, United States of America, jcochran@latech.edu, Cedric Luma

The Pythagorean method, developed and applied to Major League Baseball by Bill James over 30 years ago, has been extended to NFL and NCAA (American) football, NCAA and NBA basketball, and NHL hockey. We explore the application of James' Pythagoras method to the English Premier and Spanish Football Leagues, and consider the optimal functional form and parameters for such a model. We compare the results for the two leagues and look at changes across several seasons.

■ MA13

Level 2 - Room 202A

Collaboration in New Product Development

Cluster: New Product Development

Invited Session

Chair: Svenja Sommers, Associate Professor, HEC Paris, 1, Rue de la Liberation, Jouy-en-Josas, 78351, France, sommers@hec.fr

1 - Effect of Bargaining Power and Information Asymmetry on Product Quality in Outsourcing

Narendra Singh, Ph.D. Candidate, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Narendra.Singh@scheller.gatech.edu, Stylianos Kavadias, Ravi Subramanian

We examine the effect of outsourcing on product quality when the OEM has a backup option of manufacturing the product herself. We characterize the situation as a game-theoretic model consisting of sequential decisions made by the OEM and the contract manufacturer (CM) in two scenarios - the CM offering the contract to the OEM, and vice-versa. We contrast the results for the two scenarios in the absence and presence of information asymmetry about cost structure.

2 - Licensing Contracts: Control Rights and Options

Niyazi Taneri, Singapore University of Technology and Design, 20 Dover Drive, Singapore, Singapore, niyazitaneri@sutd.edu.sg, Pascale Crama, Bert De Reyck

We investigate how contract structure - payment terms and control rights - influence R&D collaborations. Surprisingly, under certain conditions, the innovator prefers to limit its own actions by granting launch control rights or buy-out options to the marketer. We show that the nature of the effect of R&D effort has a major influence on optimal contract structure. Our results demonstrate that allocation of control rights can have a significant influence on success, quality and profitability.

3 - Benefits and Shortcomings of Flexibility in Collaborative Prototyping

Timofey Shalpegin, HEC Paris, 1 Rue de la Liberation, Jouy en Josas, 78350, France, timofey.shalpegin@hec.edu, Svenja Sommers, Zhixi Wan

Manufacturers often involve suppliers to develop innovative components. Suppliers in their turn provide manufacturers with several prototypes of the component. We model the sequential prototyping problem as a dynamic non-cooperative game. We examine and compare three schemes of collaboration between manufacturers and suppliers which provide different level of flexibility for manufacturers. We show that under some conditions additional flexibility can be harmful for manufacturers.

4 - Optimal Investment in Late Stage New Drug Development

Zhili Tian, Assistant Professor, Towson University, 8000 York Rd, Towson MD 21252, United States of America, zhili.a.tian@gmail.com

Firms conduct Phase 3 drug trials by enrolling and treating patients that meet a set of conditions. Finding the patients is expensive and time consuming, with uncertainty around these. We determine the optimal investment policy. This must be done recognizing that there is uncertainty in the outcome of a trial. As trial duration increases, the patent protection period decreases, leading to lowered returns. We develop analytic results and provide conditions for accelerating or suspending a trial.

■ MA14

Level 2 - Room 202B

Supply Chain Risk and Optimization

Cluster: Managing Disruptions in Supply Chain

Invited Session

Chair: Ed Pohl, Professor, Department of Industrial Engineering, University of Arkansas, Fayetteville, AR, 72701, United States of America, epohl@uark.edu

1 - Cargo Prioritization and Terminal Allocation for Inland Waterway Disruptions

Jingjing Tong, Ph.D. Candidate, University Of Arkansas, 4207 Bell Engineering Center, University of Arkansas, Fayetteville, AR, 72701, United States of America, tong@email.uark.edu, Heather Nachtmann

For an ongoing project funded by the U.S. Department of Homeland Security, we have developed a nonlinear binary integer program for cargo prioritization and terminal allocation problem (CPTAP) that minimizes the total value loss of the barge cargoes when the inland waterway is closed or reduced due to a disruption. The model delivery indicates the terminal that each disrupted barge is assigned to for offloading and the prioritized turn each barge takes at its assigned terminal.

2 - Models for Designing Reliable Biofuel Supply Chains

Mohammad Marufuzzaman, Research Assistant, Mississippi State University, PO Box 9542, Industrial & Systems Engineering, Starkville, MS, 39759, United States of America, maruf237@gmail.com, Sandra Eksioglu, Xiaopeng Li, Jin Wang

We present a model to identify biorefinery locations which ensure a cost-efficient and reliable supply chain designs. This model takes into consideration the cost benefits and risks associated with locating biorefineries near intermodal hubs, such as, inland ports, sea ports and rail ramps. We developed an accelerated Benders decomposition approach to solve large instances of this problem. We validate the model on a case study using data from the southeast region of USA.

3 - Hybrid Gradient Search for Optimizing Biopharmaceutical Supply Chain Decision-making

Stewart Liu, PhD Student, University of California- Berkeley, 4141 Etcheverry Hall, MC1777, Berkeley, CA, 94720, United States of America, stewart_liu@berkeley.edu, Phil Kaminsky

Motivated by our success in solving stochastic supply chain optimization problems in the biopharmaceutical industry using retrospective optimization, we present a hybrid retrospective optimization-stochastic gradient search algorithm that in initial empirical testing is both fast and effective. This method uses short time horizon optimization problems as a starting point for stochastic gradient search, and is significantly faster than retrospective optimization approaches.

■ MA15

Level 2 - Room 203

Workforce Management I

Sponsor: Service Science

Sponsored Session

Chair: Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, mss@us.ibm.com

1 - Asymptotics of a Class of Workforce Capacity Planning Problems

David Yao, Columbia University, Dept. of IEOR, New York, NY, United States of America, yao@columbia.edu, Yingdong Lu, Mark Squillante

We study the capacity problem of matching the supply of resources and the uncertain demand for resources over a planning horizon of N periods, with the provision that a set of resource capacity decisions must be made before the first period. Our approach consists of constructing upper- and lower-bounds for the expectation of the running maximum of the difference between cumulative demand and cumulative capacity up to period n, and analyzing the asymptotic behavior of these bounds for large N.

2 - Asymptotic Properties of a Class of Stochastic Loss Models

David A. Goldberg, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, dgoldberg9@isye.gatech.edu, Yingdong Lu, Mayank Sharma, Mark Squillante, Dmitriy Katz

Stochastic models in which an opportunity is lost when insufficient resources are available to fulfill demand arise naturally in workforce management applications, where the lead times on resource availability can be quite large. We derive asymptotic properties of a class of such stochastic workforce loss models.

3 - Capacity Planning for a Class of Large-scale Loss Networks

Yingdong Lu, IBM T.J. Watson Research Center, 1101 Kitchawan Rd., Yorktown Heights, NY, United States of America, yingdong@us.ibm.com, Yue Tan, Cathy Xia

We consider the problem of determining the optimal capacity levels in a general class of large-scale loss networks.

4 - Optimal Capacity Management and Planning in Services Delivery Centers

Aliza R. Heching, IBM TJ Watson Research Center, Mathematical Sciences, Yorktown Heights, NY, United States of America, ahechi@us.ibm.com, Mark Squillante

We consider optimal capacity management of systems of queues that arise in services delivery centers. The traditional approach is simulation-optimization whose computational costs are prohibitive for large systems. We develop a two-phase stochastic optimization approach that combines analytical and simulation methods. Numerical experiments demonstrate that our solution approach provides a reduction of several orders of magnitude in computational costs over traditional simulation-optimization.

■ MA16

Level 2 - Room 204

Bonder Scholar

Sponsor: Health Applications

Sponsored Session

Chair: Murat Kurt, Assistant Professor, University at Buffalo, SUNY, North Campus, 309 Bell Hall, Buffalo, NY, 14260, United States of America, muratkur@buffalo.edu

1 - Optimal Information Acquisition Policies: Application to HCV Screening

Lauren Cipriano, Assistant Professor, Western University, Ivey Business School, London, ON, Canada, lcipriano@ivey.uwo.ca, Shan Liu, Thomas Weber, Jeremy Goldhaber-Fiebert

Standard practice for value of information analyses does not include the option to delay information collection. We demonstrate that when parameters vary across cohorts, as with hepatitis C (HCV) screening, the optimal information collection policy, for both time-varying and static parameters, may be to delay information collection. We apply our dynamic programming framework to identify the optimal information collection policy for three critical parameters in the evaluation of HCV screening.

2 - Time to Abandon Nonabandonment? HIV in Resource-limited Settings

Amin Khademi, Assistant Professor, Clemson University, 110 Freeman Hall, Clemson, SC, 29634, United States of America, amk130@pitt.edu, Mark Roberts, Andrew Schaefer, Denis Saure

The global fight against HIV is hindered by a lack of drugs in the developing world. When a patient in these countries is offered treatment, she typically remains on treatment until death, as policy makers and physicians follow an nonabandonment policy. However, in many cases another patient might benefit more from the drugs, as resistance to them increases. We quantify the cost of these nonabandonment policies. We show that this cost can be as much as 40% of the total benefit of the drugs.

3 - Healthcare Operations Research: Research, Teaching and Service

Mariel Lavieri, Assistant Professor, University of Michigan, 1205 Beal Ave., 2783 IOE, Ann Arbor, MI, 48105, United States of America, lavieri@umich.edu

As a 2006 Bonder Scholar, I share my experiences doing research in the field of healthcare operations research and discuss some of my most resent work in the field of medical decision making for chronic disease patients. I will conclude the talk by describing teaching and outreach activities developed to motivate underrepresented students to consider this growing field of research.

4 - Kolmogorov-Smirnov Statistic-Based Optimization for Causal Inference with Observational data

Murat Kurt, Assistant Professor, University at Buffalo, SUNY, North Campus, 309 Bell Hall, Buffalo, NY, 14260, United States of America, muratkur@buffalo.edu, Alexander Nikolaev

When randomized experiments are hard or impossible to conduct, accurate assessment of treatment effects becomes difficult due to presence of confounding factors. We consider the problem of treatment effect estimation based on observational data and develop a mixed-integer programming model to identify a control group that is statistically indistinguishable from a fixed treatment group according to Kolmogorov-Smirnov statistic. We present computational results on a diverse array of datasets.

■ MA17

Level 2 - Room 205A

Service Evolution

Sponsor: Service Science

Sponsored Session

Chair: Rahul Basole, Associate Professor, Georgia Institute of Technology, 85 Fifth St., NW, Atlanta, GA, 30332, United States of America, basole@gatech.edu

1 - Business Activity Networks

Andre Calmon, Massachusetts Institue of Technology, 77 Massachusetts Avenue, E62-364, Cambridge, MA, 02139, United States of America, acalmon@mit.edu, Jorge Sanz

Leveraging data from multiple industries, we introduce the concept of a Business Activity Network, i.e., the network formed by the union of different business processes that exist within a service company. We study the statistical properties of these networks and propose generative models that describe the growth of activities within a company. In addition, we discuss the relationship between the structure of the Business Activity Network of a company and vulnerability towards external shocks.

2 - Evolution of Product and Service Provider Networks: An Empirical Analysis and Visualization

Hyunwoo Park, PhD Student, Georgia Institute of Technology, 755 Ferst Dr. NW, Main Bldg. Rm 128, Atlanta, GA, 30332, United States of America, hwpark@gatech.edu, Rahul Basole

We examine how the network structure among service providers, product manufacturers, and platform providers have shaped inter-firm coordination of nearly 1,500 smartphone launches in the mobile ecosystem between 2000-2012. Network analysis on a tripartite graph—consisting of product-service-platform triads—reveals dynamic patterns of strategic service alliance and switching between platforms. We complement our analysis with network visualizations and discuss service-level strategic implications.

■ MA18

Level 2 - Room 205B

Optimization

Sponsor: Service Science

Sponsored Session

Chair: Jason Sauppe, PhD Student, University of Illinois at Urbana-Champaign, 201 North Goodwin Avenue, Urbana, IL, 61801, United States of America, sauppe1@illinois.edu

1 - Improving the Distribution System for the FKB Program at the Regional Food Bank of Oklahoma

Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu

This paper presents the application of an optimization model based on a mixed-integer programming to solve a cost optimization problem for one of the programs of the RFBO; the Food for Kids Backpack program (FKBP). The objective of this program is to provide food to kids who are considered to be "chronically" hungry at no cost in Oklahoma. A myopic policy solution with an algorithmic approach to the cost distribution problem is followed.

2 - BPM Collaborates with Packaged Enterprise System for Balanced IT System

Qinhua Wang, IBM Research China, Zhongguancun Software Park, Beijing, China, wangqinh@cn.ibm.com, Qiang Wei, Feng Chen

Enterprises' IT requirements have been evolved from improving efficiency to enabling collaboration and optimization. To fulfill them, business process management (BPM) tool is no longer competitive to packaged enterprise system, but complementary. This talk will introduce the solution how they work together to achieve a balanced IT system: deploying standard business processes in stable enterprise system and agile processes in BPM, and integrating them to achieve performance improvement.

3 - Improving Facility Supply Chain Efficiency through Storage and Routing Optimization

Guiping Hu, Iowa State University, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu, Nazanin Zinouri

Warehouse operation is essential for production and logistics planning. This research focuses on storage optimization, order picking and delivery improvements with emphasis on reducing the total travel time. The objective is to reduce the total system cost at a manufacturing facility. The storage and routing optimization problems are validated through simulation. The results show that warehouse operation optimization can lead to a more efficient production system.

4 - Improving the Reliability of Treatment Effect Estimates using the BOSS Model

Jason Sauppe, PhD Student, University of Illinois at Urbana-Champaign, 201 North Goodwin Avenue, Urbana, IL, 61801, United States of America, sauppe1@illinois.edu, Sheldon Jacobson, Edward Sewell

Deriving unbiased causal inferences from observational (non-random) data requires some method of adjustment to control for potential confounding factors. The Balance Optimization Subset Selection (BOSS) model formulates these adjustments as an optimization problem and uses the solution to make causal inferences. These inferences can be strengthened by using alternate optima to provide second opinions, either enhancing confidence or suggesting the presence of unobserved factors.

■ MA19

Level 2 - Room 205C

Applied Probability Research on Healthcare Applications

Sponsor: Applied Probability

Sponsored Session

Chair: Opher Baron, University of Toronto, 105 St. George St., Toronto, ON, M5S3E6, Canada, Opher.Baron@Rotman.Utoronto.Ca

1 - Adaptive and Robust Radiation Therapy in the Presence of Uncertainty Drift

Timothy Chan, Assistant Professor, University of Toronto, 5 Kings College Rd., Toronto, ON, Canada, tcychan@mie.utoronto.ca, Philip Mar

We present an adaptive, multi-stage robust optimization approach to radiation therapy treatment planning for a lung cancer case subject to tumor motion. It was previously shown that this approach is asymptotically optimal if the uncertain tumor motion distribution stabilizes over the treatment course. We show computationally that this approach maintains good performance even if the motion distribution does not stabilize but instead exhibits drifts within the probability simplex.

2 - Modeling and Simulation of a Bariatric Surgery Program

Adam Diamant, PhD Candidate, University of Toronto, Rotman School of Management, 105 St. George Street, Toronto, ON, M5S 3E6, Canada, Adam.Diamant09@Rotman.Utoronto.ca, Joseph Milner

We study the Bariatric Program at Toronto Western Hospital. The program consists of multiple visits with care providers prior to surgery. Patient wait times and abandonment have been a concern of the hospital. We apply logistic regression and survival analysis to estimate the influence of patient covariates on system time and continued participation. Transition time distribution estimates support a patient flow simulation that is used to estimate required staffing levels and throughput goals.

3 - Allocation Policies in Blood Transfusion

Vahid Sarhangian, University of Toronto, Rotman School of Management, 105 St.George Street, Toronto, ON, M5S3E6, Canada, Vahid.Sarhangian11@Rotman.Utoronto.ca, Opher Baron, Hossein Abouee Mehrizi, Oded Berman

Recent studies suggest an increased risk of adverse clinical outcomes in patients receiving transfusions of "older" blood. In order to investigate the potential of allocation policies in reducing the age of transfused blood without significantly affecting its availability, we analyze an idealized model of the blood bank of a hospital and consider a family of allocation policies. This allows us to quantify the outcome of policies and assess their benefits.

4 - Improved New Patient Appointment Scheduling at a British Columbia Cancer Centre

Claire Ma, BC Cancer Agency, 600 West 10th Avenue, Vancouver, BC, V5Z 4E6, Canada, Claire.ma@bccancer.bc.ca, Martin Puterman, Scott Tyldesly, Emma Liu, Marianne Taylor, Antoine Sauré

Motivated by an increasing demand for cancer care and long waits for new patient appointments, there is a need for better appointment scheduling. This talk describes a British Columbia study that developed advanced patient scheduling rules and used a simulation model to compare the rules in terms of wait times, resource utilization and clinic overtime for physicians. A novel aspect of this study is that the mix of oncologist specializations and physician's availability must be accounted for.

■ MA20

Level 2 - Room 205D

Market and Operations

Sponsor: Applied Probability

Sponsored Session

Chair: Itai Ashlagi, Assistant Professor, Massachusetts Institute of Technology, E-62, Cambridge, MA, United States of America, iashlagi@mit.edu

1 - House Allocation with Indifferences: A Generalization and a Unified View

Daniela Saban, Columbia University, New York, NY, United States of America, dhs2131@columbia.edu, Jay Sethuraman

We consider the problem of reallocating indivisible objects amongst a set of agents when the preferences may contain indifferences and study how the well-know results for strict preferences can be generalized to this setting. We provide a general framework to design strategyproof mechanisms that find a Pareto optimal allocation in the weak-core. We establish sufficient conditions for a mechanism to be strategyproof and use them to design fast algorithms for finding "good" reallocations.

2 - Welfare and Equity Consequences of Transplant Organ Allocation Policies

Utku Unver, Professor of Economics, Boston College, Boston, MA, United States of America, unver@bc.edu, Tayfun Sonmez

We present the first comprehensive model that analyzes welfare and equity consequences of various deceased-donor allocation, live donation, and live-donor exchange policies for transplant organ allocation. In particular, we propose a new exchange policy for live donors, to incentivize the participation of compatible pairs in exchange. We show that this policy can make all patient groups weakly better off with respect to the regular exchange policies in use.

3 - Kidney Exchange in Dynamic Sparse Heterogenous Pools

Vahideh Manshadi, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, manshadi@mit.edu, Itai Ashlagi, Patrick Jaillet

Current kidney exchange pools are of moderate size and thin, as they consist of many highly sensitized patients. Creating a thicker pool can be done by waiting for many pairs to arrive. We analyze a class of algorithms that search periodically for allocations. We perform sensitivity analysis on the amount of waiting given different types of allocations (i.e., using 2-ways, 3-ways, or chains). Our theoretical findings and data-driven computational experiments lead to policy recommendations.

■ MA21

Level 2 - Room 206

Incentives and Risk in Healthcare Systems and Markets —An Optimization Approach

Sponsor: Health Applications

Sponsored Session

Chair: Retsef Levi, Massachusetts Institute of Technology, 100 Main St., E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

1 - Discounted Referral Pricing between Healthcare Networks

Fernanda Bravo, Ph.D. Student, Massachusetts Institute of Technology, 100 Main Street, E62-459, Cambridge, MA, 02142, United States of America, fbravo@mit.edu, Angela King, Gonzalo Romero, Retsef Levi, Georgia Perakis

Academic medical centers (AMC) receive referrals from low acuity networks, and usually use a fee for service contract. We consider referrals from a capitated provider (HMO), and characterize a two-tier discount contract. Our contract is mutually beneficial based on both parties' risk preferences: it increases the AMC's expected revenue while decreasing the HMO's conditional value at risk of the cost. We extend the analysis to the case of asymmetric information about referral volume.

2 - The Power of Uniform Subsidies to Incentivize Demand – Optimal and Near-optimal Results

Gonzalo Romero, Massachusetts Institute of Technology, 100 Main Street, E62-461, Cambridge, MA, 02139, United States of America, gromeroy@mit.edu, Retsef Levi, Georgia Perakis

We analyze a subsidy allocation problem with endogenous market response under a budget constraint. The central planner allocates subsidies to heterogeneous producers to maximize the consumption of a commodity. We identify marginal cost functions such that uniform subsidies are optimal, even under demand uncertainty. This is precisely the policy usually implemented in practice. Moreover, we show that uniform subsidies have a guaranteed performance in important cases where they are not optimal.

3 - On Efficiency of Revenue-sharing Contracts in Joint Ventures in Operations Management

Cong Shi, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, shicong@gmail.com, Wei Sun, Retsef Levi, Georgia Perakis

We study capacity planning problems with resource pooling in joint ventures under uncertainties. When resources are heterogeneous, there exists a unique efficient revenue sharing contract under proportional fairness. This optimal contract rewards every player proportionally to her marginal cost. When resources are homogeneous, there does not exist an efficient revenue sharing contract. We propose a provably good contract that rewards each player inversely proportional to her marginal cost.

4 - A Dynamic Learning Model for Adaptive Licensing

Adam Elmachtoub, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, ane@mit.edu, Retsef Levi

With the increasing ability to collect and utilize data, the pharmaceutical industry is gearing towards a continuous learning approach for drug development, compared to the traditional four phase approach. Under this new approach, a drug may be released into the market as its quality is gradually understood. As more people take the drug, the quality information increases. Naturally, this leads to several interesting pricing, learning, and information challenges that we consider.

■ MA22

Level 2 - Room 207

Applications of Analytics to Patient Management

Cluster: Healthcare Systems/Informatics

Invited Session

Chair: Alex Mills, Assistant Professor, Indiana University, Kelley School of Business, 1309 E Tenth St., Bloomington, IN, 47405, United States of America, millsaf@indiana.edu

1 - HALT: Long Range Triage

David Anderson, Assistant Professor, City University of New York Baruch, 55 Lexington Ave., New York, NY, 10010, United States of America, danderson@rhsmith.umd.edu, Bruce Golden, Ryan Scilla, Edward Wasil, Mangla Gulati

Inter-Hospital Transfer Patients tend to be the most severe and resource intensive patients in large hospitals' internal medicine units. We develop a highly accurate tool based on simple characteristics to predict whether or not a patient will require an ICU bed within 48 hours of arrival.

2 - Two-stage Statistical Model for Predicting Hospital Admissions at Emergency Department Triage

Shanshan Qiu, Wayne State University, Detroit, MI, United States of America, shanshan@wayne.edu, Alper Murat, Ratna Babu Chinnam

Research suggests that boarding experienced by ED patients can be reduced if hospital admissions of patients can be predicted right during triage to trigger proactive bed requests and preparations. Using patient information readily available at ED triage, we build a two-stage statistical model that predicts likelihood of patient admission as well as the likely target ward for admission. Results from using EDIS data of Detroit VAMC are very promising.

3 - Incentive to ride? A Queueing Model of Emergency Medical Transportation with Imperfect Information

Alex Mills, Assistant Professor, Indiana University Kelley School of Business, 1309 E Tenth St., Bloomington, IN, 4740 5, United States of America, millsaf@indiana.edu

Ambulances responding to 9-1-1 calls can provide many services, but ambulance agencies are often reimbursed only for actually transporting a patient to a hospital. Medically unnecessary transports are costly and result in congestion at the ED. We use a queueing model to study the effect of reimbursement policy on transportation decisions when the ambulance service uses predictive analytics. We show that incentives can be realigned to reduce cost and congestion in the emergency medical system.

■ MA23

Level 2 - Room 208A

New Directions in Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Pavithra Harsha, IBM Research, 1101 Kitchawan Road, Room 34-225, Yorktown Heights, NY, 10598, United States of America, pharsha@us.ibm.com

1 - Pricing Managed Lanes using Simulation

Robert Phillips, Nomis Solutions, San Bruno, CA, United States of America, robert.phillips@nomissolutions.com, Caner Gocmen, Garrett van Ryzin

Managing toll lanes for profit is becoming increasingly common. We consider the problem of finding revenue-maximizing tolls for a managed lane operator — that is an operator who can charge a toll for some lanes on a highway while the others remain free to use. We present some structural results on optimal tolls and use a simulation to evaluate the performance of different tolling schemes such as myopic, static, and dynamic tolling.

2 - Designing Price Incentives in a Network with Social Interactions

Maxime Cohen, Massachusetts Institute of Technology, Cambridge, MA, United States of America, maxcohen@mit.edu, Pavithra Harsha

The recent ubiquity of social networks allows firms to collect vast amount of data on social interactions. We formulate the problem of optimizing prices for an indivisible good sold to consumers that are embedded in a social network. We derive an LP based procedure to efficiently solve the case of uniform and discriminative prices. We also propose a model where the retailer designs incentives to guarantee the influence of the buyers on neighbors and provide insights with computational examples.

3 - Personalized Pricing to Mitigate Showrooming

Shivaram Subramanian, IBM Research, 1101 Kitchawan Road, TJ Watson Research Center, Yorktown Heights, United States of America, subshiva@us.ibm.com, Pavithra Harsha, Markus Ettl

Showrooming is the practice of browsing products at a store and then buying them online, possibly at another retailer. The current practice of price-matching employed by retailers has yielded mixed results. Retailers therefore need to better engage with customers while they are in the store. We propose a real-time, mobile-enabled, personalized coupon optimization method to increase profitability and minimize lost sales. We provide illustrative computational examples and discuss the results.

4 - Foundations of Social Network Ad Optimization

John Turner, Assistant Professor, University of California - Irvine, The Paul Merage School of Business, Room SB 338, Irvine, CA, 92697-3125, United States of America, john.turner@uci.edu

We introduce revenue optimization models for placing ads in social networks, motivated by the connectivity structure of the underlying graph. We discuss some pros and cons of the underlying models, and illustrate our approach using real social graphs.

■ MA24

Level 2 - Room 208B

Computational Methods for Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Gustavo Vulcano, Associate Professor, Leonard N. Stern School of Business - NYU, 44 West Fourth St., Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu

1 - Computational RM for Online Ad Allocation

Dragos Florin Ciocan, Massachusetts Institute of Technology, 100 Main Street, Cambridge, MA, 02139, United States of America, ciocan@mit.edu, Vivek Farias

We present an algorithmic and computational methodology for Generalized Second Price online ad allocation. We show that, even with arbitrarily high user traffic volatility, a scheme that resolves a sequence of LPs achieves provable performance guarantees. Motivated by this, we present a distributed algorithm for solving massively large allocation LPs, together with an implementation of our algorithm. We prove the value of our implementation with an experiment on a real life ad dataset.

2 - Piecewise Linear Approximation for Network RM

Sumit Kunnumkal, Indian School of Business, AC4 Level 1 4116, ISB, Hyderabad, AP, India, Sumit_Kunnumkal@isb.edu, Kalyan Talluri

We investigate the piecewise-linear approximation for network RM with and without choice behavior. We show that it is tractable, and can be solved efficiently in many applications of practical interest.

3 - Upper Bounds on Assortment Optimization Problems under Mixtures of Logits

Jacob Feldman, Cornell University, School of OR & IE, Cornell University, Ithaca, NY, 14853, United States of America, jbf232@cornell.edu, Huseyin Topaloglu

We consider assortment optimization problems where customers choose according to a mixture of multinomial logit models. We show how to obtain bounds on the optimal expected revenue and computationally test the performance of these upper bounds.

4 - Joint Optimization of Virtual Capacities and Bid-Prices for Revenue Management

Gustavo Vulcano, Associate Professor, Leonard N. Stern School of Business - NYU, 44 West Fourth St., Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu, Alex Weil

We consider a network RM problem where the physical capacity of the legs is uncertain. The controller sets a virtual capacity and a bid-price for each of the legs at the beginning of the finite horizon, and takes reservations. At the end of the horizon, the effective capacities and customer show-ups are realized. The controller incurs a penalty cost for each bumped reservation. We present a stochastic gradient algorithm for the adjusted revenue maximization problem (revenue minus penalty cost).

■ MA25

Level 2 - Room 208C

Spectrum Market Design

Cluster: Auctions

Invited Session

Chair: Robert Day, Associate Professor, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, CT, 06269-1041, United States of America, bob.day@business.uconn.edu

1 - Nash Equilibria of Sealed-bid Package Auctions

Marion Ott, RWTH Aachen University, Templergraben 64, Aachen, 52056, Germany, marion.ott@rwth-aachen.de, Marissa Beck

We characterize the sets of Nash equilibria (NE) of the Vickrey package auction (VA), minimum-revenue core-selecting auctions (MRCSA), and the pay-as-bid auction (PBA). The set of NE of the VA contains the set of NE of MRCSA, which contains all NE of the PBA. Moreover, the set of potential NE outcomes for all MRCSA and the VA includes any feasible assignment together with any payments weakly below the winners' true values.

2 - The Use of Vertex-packing Algorithms in a Clock-auction Framework for the FCC Incentive Auction

Karla Hoffman, Professor, George Mason University, Fairfax, VA, United States of America, khoffman@gmu.edu, Anthony Coudert, Rudy Sultana

The FCC proposes to incentivize incumbent TV stations owners to vacate spectrum voluntarily. A proposed clock auction allows broadcasters to choose to stay in their current spectrum band, go off the air, move from UHF to VHF, or co-share an existing channel. This auction design requires that one solve hundreds of vertex-packing problems each round. We provide a short description of the auction design and give details of the testing of alternative algorithms to solve the vertex packing problem.

3 - The Combinatorial Clock Auction, Revealed Preference and Iterative Pricing

Oleg Baranov, University of Colorado, Boulder, CO, United States of America, oleg.baranov@colorado.edu, Lawrence Ausubel

The combinatorial clock auction (CCA) has recently become a popular choice for allocating highly valuable items. CCA suffers from three major problems. First, it is not a truly dynamic "pay-as-bid" auction. Second, it creates serious tensions between activity rules and bidder incentives. Finally, CCA activity rules are known to produce bidding anomalies. We propose a CCA enhancement that includes a new set of activity rules and a dynamic pricing method that eliminates these problems.

4 - Core-pricing in Large Multi-object Auctions: A Market Design for Selling TV Ads

Robert Day, Associate Professor, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, CT, 06269-1041, United States of America, bob.day@business.uconn.edu, Pasha Shabalin, Andor Goetzendorff, Martin Bichler

Motivated by markets for television advertising time-slots, we introduce a new combinatorial auction format, including a general method for approximating core-selecting payments for hard problems which can be solved approximately. Our adaptation of the core-selecting payment technique to this environment of nearly-optimal optimization results is a new, practically viable paradigm by which competitive market outcomes can be achieved despite computational limitations.

■ MA26

Level 2 - Room 208D

Location Models in Natural Disaster Applications

Sponsor: Location Analysis

Sponsored Session

Chair: Rajan Batta, Professor, University at Buffalo - State University of New York, 410 Bell Hall, Department of Industrial & Systems Engg, Buffalo, NY, 14051, United States of America, batta@buffalo.edu

1 - Locating Vulnerable Temporary Depots Prior to a Natural Disaster

Anastatsia Nikolaeva, Master Student, University at Buffalo, 342 Bell Hall, Buffalo, NY, 14260-2050, United States of America, aanikola@buffalo.edu, Rajan Batta, Jun Zhuang

This talk addresses temporary supply depot (SD) allocation in anticipation of a hurricane. We analyze vulnerability of SDs by modeling the assignment of protection levels to them, and thereby, decreasing their chance of being affected by the disaster. We also consider vulnerability of route segments involved in supply distribution between SDs and demand points using some ideas from the Influence Maximization literature. Numerical examples will be presented to contrast with existing models.

2 - Agent-based Simulation in Extreme Event Evacuation: Examining Social Communication

Nannan Chen, Texas A&M University, 3006 ETB TAMU, College Station, TX, 77840, United States of America, nnchen@tamu.edu, Justin Yates

We develop an agent-based simulation model to capture travel patterns for extreme event evacuation problems. We consider different travel behavior groups on real-world road networks and connect individual agents via social network. Traffic information is updated in real time and can be shared among agents through their social connections.

3 - Forecast-Driven Model for Pre-positioning Supplies in Preparation for a Foreseen Hurricane

Rajan Batta, Professor, University at Buffalo - State University of New York, 410 Bell Hall, Department of Industrial & Systems Engg, Buffalo, NY, 14051, United States of America, batta@buffalo.edu, Gina Galindo Pacheco

We present a forecast-driven dynamic model that uses a combination of Decision Theory and stochastic programming for pre-positioning relief items in preparation for a foreseen hurricane. Our model uses forecast advisories issued every six hours by the National Hurricane Center (NHC) to determine the best time for starting the pre-positioning activities, and the amount and location of units to be prepositioned; as new advisories are issued, it also repositions already prepositioned units.

■ MA27

Level 2 - Room 209A

Military Applications Research at RAND

Sponsor: Military Applications

Sponsored Session

Chair: Adam Resnick, Rand Corporation, 1776 Main St., Santa Monica, CA, United States of America, Adam_Resnick@rand.org

1 - Classifying U.S. Air Force Academy and Air Force ROTC Cadets into Initial Non-rated Career Fields

Tara Terry, Operations Researcher, RAND Corporation, 1200 S. Hayes St., Arlington, VA, 22202, United States of America, tterry@rand.org, Andrew Armacost, Preston Goodrich, Jim Lowe, Jason Williams

USAFA and ROTC used LP-based approaches for matching cadets to career fields by optimizing cadet preference and class standing while constrained by career field targets. In May 2012, USAFA and ROTC were combined into one classification model while adding 3 new features: spreading cadet quality, matching desired undergrad degrees, and a new methodology to combine USAFA and ROTC class standings. We present our modeling approach, computational results, and practical implementation of the model.

2 - A Simulation of Alternative Distributions for Army Organizational Clothing and Individual Equipment

James Broyles, RAND Corporation, 1776 Main Street, Santa Monica, CA, United States of America, jbroyles@rand.org, Raffaele Vardavas

The Army has 36 US warehouses that store and issue to soldiers Organizational Clothing and Individual Equipment (OCIE). The Army is considering other distribution systems that are more centralized, perform OCIE repair and laundering, and process returns from the soldiers. This research presents a multi-echelon simulation model that estimates US stock flows, shipping quantities, and inventory fluctuations under several alternative distribution systems to inform policy decisions.

3 - Sourcing and Global Distribution of Medical Supplies

Adam Resnick, RAND, 1776 Main St., Santa Monica, United States of America, resnick@rand.org, William Welser IV

The Department of Defense provides medical care to service members all over the world and must ensure that health care providers have the proper quantity and quality of medical materiel. RAND investigated opportunities to gain efficiencies in the logistics enterprise without sacrificing capability, notably through minimizing intermediate materiel handling, seeking greater value from commercial freight, and streamlining warehouse operations.

■ MA28

Level 2 - Room 209B

Theory and International Applications I

Cluster: Data Envelopment Analysis

Invited Session

Chair: John Ruggiero, University of Dayton, Dayton, OH, United States of America, ruggiero@notes.udayton.edu

1 - A Joint Model for Computing the SBM Efficiency and Super-efficiency

Chien-Ming Chen, Assistant Professor, Nanyang Technological University, Nanyang Business School, 50 Nanyang Avenue, Singapore, Singapore, cmchen@ntu.edu.sg

We propose a method to compute SBM efficiency and super-efficiency (SE) in one model. We show that the traditional SBM-SE method may rely on weakly-efficient reference points, and that the SBM-SE score is sensitive to small data variations. We also show that the SBM model can create a space of "super-inefficiency" undetectable by the traditional SBM methods. We propose a model to overcome the above issues.

2 - Assessment of Productive and Environmental Efficiencies of Japanese Industries

Mika Goto, Senior Research Economist, Central Research Institute of Electric Power Industry, 1-6-1, Otemachi, Chiyoda-ku, Tokyo, 100-8126, Japan, mika@criepi.denken.or.jp, Akihiro Otsuka, Toshiyuki Sueyoshi

This study proposes a new use of DEA models to assess unified (operational and environmental) efficiency concerning Japanese manufacturing and non-manufacturing industries of 47 prefectures. Measuring their energy utilization and energy efficiencies, this study discusses their energy and environmental implications for development of a sustainable society.

3 - Various Measures of Efficiency of Australian Schools

John Ruggiero, University of Dayton, Dayton, OH, United States of America, ruggiero@notes.udayton.edu

We analyze production efficiency of Australian primary and secondary schools. In addition to technical efficiency, we analyze allocative efficiency while controlling for the socioeconomic environment.

4 - One-stage and Two-stage DEA Estimation of the Effects of Contextual Variables

Andrew Johnson, Texas A & M University, College Station, TX, United States of America, ajohnson@tamu.edu, Timo Kuosmanen

We re-examine the statistical properties of the 2-DEA estimator, and find that it is statistically consistent under more general conditions. We apply the result that DEA can be formulated as a convex nonparametric least squares (CNLS) regression to incorporate contextual variables in a single estimation. Evidence from Monte Carlo simulations suggests that the new 1-DEA estimator performs systematically better than the conventional 2-DEA estimator both in deterministic and noisy scenarios.

■ MA29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - SAS Global Academic Program - High-Performance Data Mining with SAS Enterprise Miner

André de Waal, Analytical Consultant, SAS Institute, SAS Campus Dr., Cary, NC, 27513, United States of America, andre.dewaal@sas.com

Very large data sets with millions of rows and computationally intensive model fitting requires massively parallel processing to be effective. High-Performance analytics exploits massively parallel processing to reduce dramatically the run time needed for the construction of analytical models. A brief overview of various computing approaches is given. This workshop then highlights the similarities and differences between the High-Performance nodes in SAS Enterprise Miner 12.1 and the classical nodes that have been available for same time in previous versions of Enterprise Miner. A software demonstration is included

2 - Forio Online Simulations – Clear and Simple High Performance Technical Computing with Julia

Westely Hennigh, Forio Simulations, 1159 Howard St., San Francisco, CA, 94103, United States of America, whennigh@forio.com

Julia is a new, high-performance dynamic programming language for technical computing that provides a sophisticated compiler, distributed parallel execution, numerical accuracy, and an extensive mathematical function library. Forio will demo its IDE for Julia that allows users to read, write, edit, and execute their Julia code and includes syntax-highlighting and code-completion.

■ MA30

Level 2 - Room 210B

Workforce Teams/Groups and Performance

Cluster: Workforce Engineering and Management

Invited Session

Chair: David Nembhard, Associate Professor, Pennsylvania State University, 310 Leonhard building, University Park, PA, 16802, United States of America, dan12@psu.edu

1 - Success and Failure of Continuous Process Improvement Teams in the Same Organization

Ken Schultz, Associate Professor, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, 45433, United States of America, Kenneth.Schultz@afit.edu

We look at some less tangible facets of organizational culture that lead to successful lean transitions and Continuous Process Improvement. We evaluated a conceptual model proposed by Lander and Liker (2007). Our study population was at Tinker Air Logistics Complex, Oklahoma City where similar lean transformations were taking place. We measured the constructs in the model through structured interviews and success independently by supervisor evaluation. We found one condition proposed by the model, Structured Improvement Processes, to be statistically significantly correlated with successful CPI. We found no evidence to contradict the other elements of the model. There is strong correlation among the constructs of the model. We further found that, at least in our sample, having structured improvement events appears to help develop some of the model elements but is not directly linked to success.

2 - Personality, Communication and Team Performance

Gretchen Macht, Ph.D. Candidate, Pennsylvania State University, 310 Leonhard Bldg., University Park, PA, 16802, United States of America, gretchen.macht@gmail.com

We consider the degree to which the Five Factor Model characteristic of individual extraversion is predictive of the overall performance of dyadic teams. Structural equation models are considered to examine the direct and indirect effects of individual extraversion on team performance. Notably, the degree of extraversion did not directly affect team performance. However, there are several models that indicate significant relationships between extraversion and team performance with communications as mediators. The current results contribute to the literature by adding further understanding of the mediating variables that exist within the personality-performance team dynamic.

3 - Optimizing a Reciprocal Workforce

Kay-Yut Chen, Hewlett-Packard, 3000 Hanover St., Palo Alto, CA, 94304, United States of America, kay-yut.chen@hp.com, Haitao Li, Alex Zhang, Pano Santos, Claudia Marquez-Nava

We integrate the "gift exchange" idea, where employees put in extra effort to reciprocate better pay, into a workforce sizing and wage determination problem. The productivities of employees are modeled as increasing nonlinear functions of wages. Numerical experiments reveal that cross training is valuable and a higher variation of productivity functions result in lower costs. The goodness of the solution and required time are sensitive to the size, and the degree of nonlinearity of the system.

■ MA31

Level 2 - Room 211A

Government Policies and Financial Markets

Sponsor: Financial Services

Sponsored Session

Chair: Stathis Tompaidis, Associate Professor, McCombs School of Business, IROM Dpt., B6500, University of Texas at Austin, Austin, TX, 78712, United States of America, Stathis.Tompaidis@mccombs.utexas.edu

1 - Optimal Government Debt Control: Explicit Formula for the Optimal Debt Ceiling

Abel Cadenillas, Professor, University of Alberta, Department of Mathematical Sciences, University of Alberta, Edmonton, Al, T6G2G1, Canada, abel@ualberta.ca, Ricardo Huaman

Motivated by the current debt crisis in the world, we consider a government that wants to control optimally its debt ratio. The debt generates a cost for the country. The government can reduce the debt ratio, but there is a cost associated with this reduction. We obtain a solution for the government debt problem. In particular, we obtain an explicit formula for the optimal debt ceiling.

2 - Stochastic Control of Interest Rates

Daniel Mitchell, University of Texas, McCombs School of Business, Austin, TX, United States of America, daniel.mitchell@phd.mccombs.utexas.edu, Haolin Feng, Kumar Muthuraman

We examine the effect that a central bank's interventions have on longer term interest rate securities. We model the central bank's intervention as a stochastic control problem on a general class of processes, and develop a computational method to solve the problem. Using this method we solve for the central bank's optimal control policy and also study the effect of this on longer term interest rate securities using a change of measure.

3 - Bounding Wrong-way Risk

Linan Yang, PhD Student, Columbia University, IEOR Department, New York, NY, 10027, United States of America, ly2220@columbia.edu, Paul Glasserman

Counterparty risk depends on the interaction between market and credit risk. Positive dependence between the two creates "wrong-way risk". The dependence between market and credit risk is difficult to model, so we develop methods for bounding it by finding the worst-case joint distribution given constraints on the marginal models of market and credit risk. We also develop a method to interpolate between the worst case and the independent case based on the degree of uncertainty in the dependence.

4 - Efficiency-based Quantitative Currency Selection

Irene Song, Columbia University, Columbia University, 120 Street, New York, NY, 10027, United States of America, is2306@columbia.edu, Iraj Kani, Soulaymane Kachani

In this talk, we propose an efficiency-based currency selection methodology that combines data envelopment analysis (DEA), a non-parametric productivity analysis of relative efficiencies of economic entities, with fundamental analysis in a disciplined manner. Using this methodology, we construct and analyze several representative structural exchange rate models, including flexible-price monetary model, sticky-price monetary model, trade-weighted dollar model and their extensions.

■ MA32

Level 2 - Room 211B

Novel Research in Technology Management

Sponsor: Technology Management

Sponsored Session

Chair: Zhijian Cui, Assistant Professor of Operations Management, IE Business School, Calle de Maria de Molina, 12, Madrid, Spain, Zhijian.Cui@ie.edu

1 - Project Management under Uncertainty - How (and When) to Encourage Help

Fabian Sting, Erasmus University, Rotterdam, Netherlands, fsting@rsm.nl, Yaozhong Wu, Pascale Crama

Inspired by a real-life NPD organization, we present a model of a project management system that incorporates cooperative behavior. Core element of the system is that project managers may mutually ask for and provide help. We study the system's performance in various environments. A natural order of projects emerges, even with symmetrical projects: the firm induces different effort levels for projects. This order also explains the value of help under correlated uncertainties between projects.

2 - Operationalizing Strategy and the Specificity of Communication

Jeremy Hutchison-Krupat, Assistant Professor, Darden School of Business, University of Virginia, 100 Daredn Blvd, Charlottesville, VA, 22903, United States of America, krupatj@darden.virginia.edu

The implementation of a firm's strategy often begins when senior management communicates it to the employees that are ultimately tasked with operationalizing the strategic initiatives that will support the firm's objectives. This paper investigates how the level of detail that senior management communicates for a particular strategic initiative could influence the actions of a cross-functional team.

3 - Hierarchy and Evolvability of Innovation Ecosystems

Jianxi Luo, Assistant Professor, Singapore University of Techonology & Design, Engineering Product Development, 20 Dover Drive, Singapore, 138682, Singapore, luo@sutd.edu.sg, Eric Lucas

We model an innovation ecosystem as a directed network of firms, simulate a full spectrum of such networks with varied hierarchy degrees, and evaluate their "performance landscapes" using "NK model". Results show hierarchy in ecosystems gives rise to landscape ruggedness, indicating a higher chance for an ecosystem to be locked at local optima and unable to evolve, and higher tendency of firm behaviors and strategies toward exploitation rather than exploration.

4 - Cost-reducing Innovation and the Role of Patent Intermediaries

Shantanu Bhattacharya, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, shantanu.bhattacharya@insead.edu, Sameer Hasija, Anupam Agrawal

Patent intermediaries act as non-practicing entities, who buy innovations from an external provider and then license them to practicing firms. This paper considers the competition between two identical incumbent firms and a patent intermediary for acquiring a cost-reducing innovation from an external innovator. The analysis of the model shows that patent intermediaries participate in patent markets only if the innovation is incremental.

■ MA33

Level 2 - Room 211C

Business Analytics in Railroads

Sponsor: Railway Applications

Sponsored Session

Chair: Krishna Jha, Innovative Scheduling, 2153 SE Hawthorne Road, Gainesville, Fl, 32641, United States of America, krishna.jha@innovativescheduling.com

1 - Simultaneous Train Rerouting and Rescheduling on an N-track Network

Xuesong Zhou, University of Utah, MCE Building 2135, 110 S. Central Campus Dr., Salt Lake City, UT, 84112, United States of America, xzhou99@gmail.com

This research develops a cumulative flow count based integer programming formulation for the problem of train dispatching on an N-track network, by means of simultaneously rerouting and rescheduling trains. The track capacities are modeled as side constraints and further dualized through a Lagrangian relaxation solution framework. The original complex problem is then decomposed into a sequence of single train rerouting/rescheduling subproblems.

2 - Simulation-enabled Analytics at CSX

Jeremiah Dirnberger, Manager-Operations Planning, CSX, 500 Water St., J315, Jacksonville, FL, 32202, United States of America, Jeremiah_Dirnberger@csx.com, Yu Wang, Ivan Atanassov, Krishna Jha

The development of advanced simulation tools for terminal modeling at CSX and other railroads has created the opportunity to leverage the large amounts of data provided by these tools to describe, predict and improve terminal performance. This presentation will discuss some of the foundational relationships of terminal performance as a function of train arrival performance, train length and spacing. It will also review the relationship between the number of blocks and terminal capacity.

3 - Improving Railroad Service Design through Analytics

Todd Workman, Canadian Pacific, Calgary, AB, Canada, todd_workman@cpr.ca, Ravindra Ahuja, MohammadReza Baharnemati

Canadian Pacific Railway (CPR) generates a lot of data related to shipment, block, and trains, which is stored in our data warehouses. Accessing and analyzing this large amount of data in a timely manner has been a challenge for us. To address this, we have recently built a data analytics system. In this presentation, we will give an overview of this system and describe how we are using this system to answer various questions faced by the service design department and create better train plans.

■ MA34

Level 2 - Room 211D

Simulation Output Analysis

Sponsor: Simulation Society

Sponsored Session

Chair: Sigrun Andradottir, Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, sa@isye.gatech.edu

1 - "Online" Quantile and Density Estimators

Raghu Pasupathy, Associate Professor, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, pasupath@vt.edu, Soumyadip Ghosh

We present alternative quantile and density estimators that require dramatically less storage than traditional estimators, with negligible loss in convergence rate to the true quantile and density respectively. The proposed estimators are constructed by accumulating observed random variates into a grid that becomes finer in a strategic fashion. We will present results on the asymptotic behavior of the new estimators along with some numerics.

2 - On Estimating Quantile Sensitivities via Simulation

Guangxin Jiang, Tongji University, 1239 Siping Road, Shanghai, 200092, China, divi-msn@hotmail.com, Michael Fu

We present a simple framework for estimating quantile sensitivities by infinitesimal perturbation analysis (IPA). We also consider the likelihood ratio (LR) and weak derivative (WD) methods, and discuss the strengths and weakness of each method. Simulation experiments are used to compare the performances of the three methods.

3 - Simulation Cloning with Induced Negative Correlation

Judy Lee, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, jlee@isye.gatech.edu, Sigrun Andradottir, Richard Fujimoto

Simulation cloning expedites simulation experiments by sharing computational results among different sample paths. We study the use of simulation cloning for estimating transient performance measures. We consider basic cloning with one or more decision points. Also, we induce negative correlation to reduce variance. When simulating a replication is costly and variability is larger in the replicated part, cloning can significantly improve the efficiency of the simulation.

■ MA35

Level 2 - Room 212A

Technology Based Services in Retailing

Sponsor: E-Business

Sponsored Session

Chair: Amit Mehra, Assistant Professor and ISB Research Fellow, Indian School of Business, Hyderabad, India, Amit_Mehra@isb.edu

1 - Retail Video Analytics: An Application to Measuring the Effectiveness of Sales Assistance

Aditya Jain, Indian School of Business, AC 4, 4117, ISB Campus, Hyderabad, India, Aditya_Jain@isb.edu, Nils Rudi, Sanjog Misra, Serguei Netessine

Assistance offered by salesperson to a customer influences probability and size of purchase. We construct a model of consumer's in-store behavior that treats sales assistance as an information device to update customer's beliefs. The provision of sales assistance, however, itself depends on customer characteristics and this creates a source of endogeneity. We propose an empirical framework that addresses this and calibrate it using a unique dataset constructed from in-store video surveillance.

2 - Competition with Search Engine Optimization and Sponsored Search

Amit Mehra, Assistant Professor and ISB Research Fellow, Indian School of Business, Hyderabad, India, Amit_Mehra@isb.edu

A search engine results page is the gateway for Internet traffic. Search engine optimization drives traffic through organic links while sponsored search drives traffic through sponsored links. Both types of advertising can be synergistic, but can also be substitutes. We analyze both types of advertising and offer insights into how both of these can be used together for maximum benefit.

■ MA36

Level 2 - Room 212B

Efficient Utilization of Public Services and Programs for Improving Public Health

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Irem Sengul, North Carolina State University, Raleigh, NC, United States of America, isengul@ncsu.edu

1 - Dynamic, Robust Location Decisions to Improve Accessibility of Public Health Services

Jessica Heier Stamm, Kansas State University, Manhattan, KS, United States of America, jlhs@k-state.edu

In humanitarian and public health settings, organizations act independently to locate facilities to serve an affected population. In this decentralized, dynamic environment, accessibility may suffer in comparison to a system where a single planner locates facilities to optimize access for all. Centralized models are complicated by parameter uncertainty and efficiency – equity tradeoffs. We propose methods to address these challenges and apply them to cholera treatment facility location in Haiti.

2 - Ideal Disaster Relief: using the IFRC Code of Conduct in Model Development

John Coles, Ph.D. Student, University at Buffalo, 306 Sundridge Dr., Buffalo, NY, 14228, United States of America, jbcoles@buffalo.edu, Jun Zhuang

As the number and impact of disasters have increased, there has been great interest from the research community model and provide solutions for some of the challenges in the field. However this research has not always been guided by an understanding of the complex and nuanced challenges faced by people working in disaster relief. In this paper we propose a model for the International Federation of Red Cross and Red Crescent Societies (IFRC) Code of Conduct (CoC) for use in relief operations.

3 - Demand vs. Supply-side Investment in Humanitarian Operations

Karthik Natarajan, Assistant Professor, University of Minnesota, Carlson School of Management, Minneapolis, MN, 55435, United States of America, knataraj@umn.edu, Jayashankar Swaminathan

Addressing both supply- and demand-side constraints are vital to increasing coverage in humanitarian settings. We study the problem of identifying the optimal mix of supply- and demand-side investments in a budget-constrained environment and offer insights into the impact of supply- and demand-side parameters on the investment mix. We also consider a decentralized setting where demand mobilization activities are contracted to a third party and identify coordinating performance-based contracts.

4 - Modeling for Equitable and Effective Food Distribution in North Carolina under Capacity Constraints

Irem Sengul, North Carolina State University, Raleigh, NC, United States of America, isengul@ncsu.edu, Julie Ivy, Reha Uzsoy

In partnership with the Food Bank of Central & Eastern North Carolina, which distributes food to a 34-county service area, our objective is to determine the equitable and effective distribution of donated food among the people at risk for hunger. This presentation focuses on deterministic network flow models for optimal food distribution and their robust counterparts while considering the effect of distribution capacities. We obtain optimal policies for food distribution and capacity allocation.

■ MA37

Level 2 - Room 213A

Supply Chain Scheduling and Optimization

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Lei Lei, Professor, Rutgers Business School, 94 Rockefeller Road, Piscataway, NJ, 08854, United States of America, llei@business.rutgers.edu

Co-Chair: Zhi-Long Chen, Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, zchen@rhsmith.umd.edu

1 - The Coordinated Scheduling of Production and Two-stage Transportation

Feng Li, PhD, The Logistics Institute, Northeastern University, Shenyang, 110819, China, fengli055@gmail.com, Lixin Tang, Zhi-Long Chen

Motivated by applications in the steel industry, we study an integrated scheduling model of production and two-modal transportation. A set of jobs are first processed in a plant, delivered from the plant to the port by vehicles, and delivered from the port to the customers by ships. The problem is to find a joint schedule of production, vehicle transportation, and ship transportation such that an objective function is optimized.

2 - Production Scheduling with Batching in Continuous Annealing Plant

Lixin Tang, Northeastern University in China, The Logistics Institute, China, qhjytlx@mail.neu.edu.cn, Yang Yang

This presentation studies the steel coil scheduling problem with batching decision in multiple continuous annealing lines. The problem is formulated as a mixed integer linear programming model with uncertain processing time. To solve the problem, a hybrid method of optimization via simulation and branch-and-pricing algorithm is proposed to tackle the problem. Finally, the computational experiment results illustrate the efficiency of the proposed model and method.

3 - Operations Scheduling Problems with Renewable and Non-renewable Resources

Shengbin Wang, North Carolina A&T State University, 1601 East Market Street, Greensboro, NC, 27411, United States of America, swang@ncat.edu, Lei Lei

We consider an operations scheduling problem that is constrained by both renewable and non-renewable resources. Each operation requires a specified amount of non-renewable resources released over the time, and a deadline for the completion time. Availability of the renewable resources depends on the sequence of the operations. An approximation solution to minimize the total tardiness is proposed and analyzed.

4 - B2C Trade-in Program Design and the Role of Retailers

Fei Qin, PhD Candidate, University of Cincinnati, Carl H. Lindner College of Business, Cincinnati, OH, 45221, United States of America, qinfi@mail.uc.edu, Uday Rao, Michael Fry

B2C trade-in programs where used consumer products can be returned for cash payment or store credits are increasing in popularity for broad product categories. We study the structure of trade-in programs to understand their effectiveness and efficiency. In comparing decentralized supply chain performance, we show the fraction of returns going to the secondary retail market to be the key for the trade-in firm's incentives to coordinate the used-product collection and the secondary retail.

5 - Drayage Operations Optimization for Intermodal Transportation
Weiwei Chen, Operations Researcher, General Electric Global Research, 1 Research Circle, Niskayuna, NY, 12309, United States of America, chenw@ge.com, Leyuan Shi

The intermodal transportation combines the cost-effectiveness of rail with the flexibility of trucks. The truck portion, called drayage, is a significant component of the total cost. Drayage is concerned with the optimal movement of a set of loads between customer locations and rail ramps in a local service area. We study the optimal scheduling of drayage operations, as well as the best strategy to consider its stochastic counterpart with uncertain loads which may materialize during the day.

■ MA38

Level 2 - Room 213B

Applications of Multiple Criteria Decision Making

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Murat Koksalan, METU, IE Dept., METU, Ankara, Turkey, koksalan@metu.edu.tr

1 - Balance Concerns in Allocation Problems
Ozlem Karsu, London School of Economics, Houghton Street, London, WC2A 2AE, United Kingdom, O.Karabulut@lse.ac.uk, Alec Morton

We consider allocation problems where inputs are allocated to different entities such as projects or departments. In such problems a common goal is achieving a desired balance in the allocation over different categories of the entities. We propose a two dimensional framework for trading balance off against efficiency. We define and categorize reference line based balance indicators and propose formulations and solution algorithms which provide insight.

2 - Exact and Approximation Algorithms for Finding the Nadir Point
Murat Koksalan, METU, IE Dept., METU, Ankara, Turkey, koksalan@metu.edu.tr, Banu Lokman

Finding the nadir point is hard for more than three objectives. The difficulty further increases for integer programming problems. We develop an exact and an approximation algorithm to find the nadir point in multi-objective integer programs. We demonstrate on several instances of multi-objective assignment, knapsack, and shortest path problems that the algorithms work well.

3 - Analysis of Multivariate Loss Functions under Preferential and Statistical Dependencies
Leman Esra Dolgun, Anadolu University, Anadolu University Industrial, Engineering Department, Eskisehir, Turkey, ledolgun@anadolu.edu.tr, Levent Eriskin, Gülser Köksal

One of the challenging problems in quality management is simultaneous consideration of multiple quality responses in selection of design parameter levels for robust products. Multivariate loss functions are widely used in this type of multiresponse optimization problems. We present results of analyses we have conducted on the ability of multivariate loss functions to incorporate predefined preferential and statistical dependence structures among responses.

4 - Desirability Functions in Multiresponse Optimization
Gülser Köksal, Middle East Technical University, METU Industrial Engineering Department, Ankara, 06800, Turkey, koksal@metu.edu.tr, Basak Akteke Ozturk, Gerhard Weber

Desirability functions are widely used in optimization of multiple responses such as quality characteristics for robust products and processes. In this study structural characteristics of desirability functions are analyzed for different types of responses and interactions among them. Optimization approaches for multiresponse optimization models based on desirability functions are discussed, new methods are proposed and compared with each other.

■ MA39

Auditorium 3

Daniel H. Wagner Prize I

Cluster: Daniel H. Wagner Prize

Invited Session

Chair: Allen Butler, President, Daniel H Wagner Associates, Inc., 2 Eaton Street Suite 500, Hampton, VA, 23669, United States of America, Allen.Butler@va.wagner.com

1 - Wagner Prize
Allen Butler, President, Daniel H Wagner Associates, Inc., 2 Eaton Street Suite 500, Hampton, VA, 23669, United States of America, Allen.Butler@va.wagner.com

The competition for the 2013 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in sux finalists, who submitted papers to the judging committee and who will present their results in three sessions . The winner will be announced and give a reprise in a Tuesday afternoon Keynote session.

2 - SPRINT: Optimization of Staff Management for Desk Customer Relations Services at HERA
Daniele Vigo, University of Bologna, viale Risorgimento, 2 - 40136, Bologna, Italy, daniele.vigo@unibo.it, Claudio Caremi, Angelo Gordini, Sandro Bosso, Giuseppe D'Aleo, Beatrice Beleggia

SPRINT is a decision support system for the optimization of staff management of desk customer relations services at HERA, one of the largest Italian multi-utility companies. SPRINT is based on state-of-the-art demand forecasting and optimization frameworks that obtained very good performance with respect to other existing methods. After two years of service, SPRINT introduced a large level-of-service improvement of desk customer services, together with a relevant increase of staff productivity.

3 - An Integrated Load Planning Algorithm for Outbound Logistics Optimization
Burcu Keskin, University of Alabama, 300 Alston Hall, Tuscaloosa, AL, 35487, United States of America, bkeskin@cba.ua.edu, Charles Sox, Ibrahim Capar, Nickolas Freeman

We develop an integrated model to optimize loading and routing decisions of an auto-parts supplier's outbound supply chain. Three transportation modes, dynamic demands, and limited inventory are some challenging aspects. We decompose the problem into two subproblems involving assignment of customers into clusters and routing customers. The algorithm is run daily with varying dispatch rules. The results show the impact of customer locations, inventories, and due dates on outbound logistics costs.

■ MA41

Level 1 -101A

New Topics in Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Hamid Nazerzadeh, Assistant Professor, Marshall School of Business, University of Southern California, Los Angeles, CA, United States of America, hamidnz@marshall.usc.edu

1 - Risk Taking over Networks: Insufficient Precautions
Azarakhsh Malekian, Massachusetts Institute of Technology, 77 Massachusetts Ave., 32D-632, Cambridge, MA, 02138, United States of America, azarakhsh.malekian@gmail.com, Asuman Ozdaglar, Daron Acemoglu

We introduce a theoretical model of the security investments in a network of interconnected agents and characterize the impact of network structure on equilibrium and optimal investments. We also show that when the attack location is endogenized, there is an additional incentive for overinvestment: greater investment by an agent shifts the attack to other parts of the network.

2 - A Dynamic Graph Model of Barter Exchanges
Yashodhan Kanoria, Assistant Professor, Columbia University, Columbia Graduate School of Business, Uris Hall, 3022 Broadway, New York, NY, 10027, United States of America, ykanoria@columbia.edu, Ross Anderson, Itai Ashlagi, David Gamarnik

Motivated by barter exchanges, we study average waiting time in a dynamic random graph model. A node arrives at each time step. A directed edge is formed with probability p with each node currently in the system. If a cycle is formed, of length no more than 3, then that cycle of nodes is removed immediately. We show that the average waiting time for a node scales as 1/p^{3/2} for small p, for this policy. Moreover, we prove that we cannot achieve better delay scaling by batching.

3 - Optimal Dynamic Mechanism Design with Costly Information Acquisition
Negin Golrezaei, University of Southern California, 1230 W.29TH ST. Apt. 10, LOS ANGELES, Ca, 90007, United States of America, golrezae@usc.edu, Hamid Nazerzadeh

We study the role of the information revelation and acquisition in online advertising auctions. In online advertising, cookies provide valuable information for advertisers. We consider the problem of designing optimal mechanisms for the setting that advertisers incur cost to acquire such additional information via cookie-matching services. Our mechanism maximizes the virtual surplus considering the cost of information acquisition.

■ MA42

Level 1 -101B

Empirical Healthcare Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Diwas KC, Emory University, 1300 Clifton Road, Atlanta, GA, 30322, United States of America, diwas.kc@emory.edu

1 - Physician Workload in Primary Care

Hessam Bavafa, Ph.D. Candidate, The Wharton School, University of Pennsylvania, Philadelphia, PA, United States of America, bavafa@wharton.upenn.edu, Christian Terwiesch

Our first goal in this paper is to shed light on the effect of physician workload on physician productivity and patient outcomes. Our second goal is to see how the effects of workload are impacted by the available workload diversion channels. Using a dataset of patient visits to a large primary care system, we provide a deeper understanding of the effects of workload on primary care physicians and the effectiveness of diversion mechanisms.

2 - Is Ambulance Diversion an Effective Signal of ED Crowding? Evidence from a Natural Experiment

Eric Park, Northwestern University, Kellogg School of Management, Evanston, IL, United States of America, eric-park@kellogg.northwestern.edu, Sarang Deo, Itai Gurvich

We study the effect of a policy change that was intended to reduce ambulance diversions in LA County, CA. We find that the new policy succeeded in its purpose of reducing the time spent on diversion but did not reduce the fraction of ambulances being diverted. A possible explanation for this outcome, identified by our empirical analysis, is a combination of reduced effectiveness of diversion signal after the policy change and neighboring hospital effect.

3 - Patient Preference in Appointment Scheduling: Insights from a Discrete Choice Experiment

Nan Liu, Assistant Professor, Columbia University, New York, NY, 10032, United States of America, nl2320@columbia.edu, Stacey Finkelstein, Margaret Kruk

Online appointment scheduling has been becoming increasingly popular among patients and providers. Understanding patient preference in medical appointments is crucial in managing such appointment systems. In this study we designed and conducted a discrete choice experiment to elicit patient preference in a large urban community health center. Our study generates insights on how patients choose appointments when facing multiple alternatives, and what factors drive patients to make such choices.

4 - Decomposing the Effect of Workload on Patient Outcomes

Nicos Savva, London Business School, Regent's Park, London, United Kingdom, nsavva@london.edu, Stefan Scholtes, Michael Freeman

Extant literature has documented that in-patient outcomes deteriorate at high workloads. In this paper, we present our work with the Delivery Unit of a large teaching hospital that investigates two mechanisms through which workload affects outcomes (i) the amount of resources dedicated to individual patient care, and (ii) the quality of execution given the resource provision. We discuss our findings and their operational (and medical) implications.

■ MA43

Level 1 -101C

Practice-Based Research in Humanitarian Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Alfonso Pedraza-Martinez, Assistant Professor, Indiana University, 1309 E 10th Street, Bloomington, IN, 47405, United States of America, alpedraz@indiana.edu

1 - Humanitarian Transportation Planning: Human and Modeling Approaches

Erica Gralla, Assistant Professor, George Washington University, 1776 G Street Suite 101, Washington, DC, 20052, United States of America, egralla@gwu.edu, Charles Fine, Jarrod Goentzel

In disaster response, a key challenge is planning and prioritizing the use of vehicles to transport humanitarian aid. The changing, urgent, multi-objective context makes it difficult to formulate and deploy useful planning models. We explore improvement approaches that build on the strengths of models and human decision-makers. The performance of models and heuristics are evaluated to identify decision-making approaches that are both effective and implementable in the humanitarian context.

2 - Improving the Distribution Network of Humanitarian Aid for the Colombian Red Cross

Fidel Torres, Associate Professor, Universidad de los Andes, Industrial Engineering Department, Bogota, Colombia, ftorres@uniandes.edu.co, Annia Guatibonza, Rafael Cuervo

The objective of this work is to formulate a policy of pre-positioning of humanitarian aid to the Colombian Red Cross through a mathematical programming model. The study proposes the optimal location of new warehouses in strategic places and suggests logistics network configuration to maximize the amount of humanitarian aid delivered to vulnerable populations. A dynamical network configuration is recommended given the seasonal behavior of demand.

3 - Impact of News Media on Humanitarian Donations

Maria Besiou, Assistant Professor, Kuhne Logistics University, Brooktorkai 20, Hamburg, Germany, Maria.Besiou@the-klu.org, Jennifer McCormick

News media play an important role during emergencies, being one of the first actors to arrive in the area of disaster, but may also be at fault for causing in-kind donations to arrive at emergency sites. These donations clog the stream of lifesaving materials that need to reach victims. It is believed that the mediatized disasters receive more funding. This research explores the use of news media volume as a potential indicator for donation volume.

4 - Vehicle Supply Chains for Disaster Response in International Humanitarian Organizations

Alfonso Pedraza-Martinez, Assistant Professor, Indiana University, 1309 E 10th Street, Bloomington, IN, 47405, United States of America, alpedraz@indiana.edu, Luk Van Wassenhove, Jon Stauffer

By modeling the vehicle supply chain of an International Humanitarian Organization, this research proposes the concept of a temporary hub in major disaster areas. Temporary hubs can: a) mitigate the operational constraints due to earmarked funding during disaster response and, b) reduce total logistics costs in years without major disasters.

■ MA44

Level 1 -101D

Bargaining and Information

Sponsor: Manufacturing & Service Operations Management/ Supply Chain

Sponsored Session

Chair: Qi Feng, Purdue University, West Lafayette, IN, 47907, United States of America, annabellefeng@purdue.edu

Co-Chair: Lauren Lu, University of North Carolina, Chapel Hill, NC, United States of America, Lauren_Lu@kenan-flagler.unc.edu

1 - To Supply or Not to Supply to a Competing Buyer

Zhibin (Ben) Yang, Assistant Professor, University of oregon, United States of America, zyang@uoregon.edu, Haresh Gurnani, Xinxin Hu

We study the supplier's allocation of limited production capacity to a buyer that sells to the same market, using a three-stage model. We characterize the buyer and the supplier's market competition equilibrium in which the buyer may strategically withhold excessive supply, and analyze the supplier's capacity allocation and pricing decisions.

2 - Bargaining for an Assortment

H. Sebastian Heese, Indiana University, 1309 E 10th St., Bloomington, IN, United States of America, hheese@indiana.edu, Goker Aydin

A retailer's assortment decision results from a process of give-and-take, during which the retailer may bid manufacturers against one another. We adopt a bargaining framework to capture such an assortment selection process. In our model, the retailer engages in simultaneous, bilateral negotiations with all manufacturers. We characterize the unique bargaining equilibrium, which specifies the profit allocated to the retailer and to each manufacturer.

3 - Capacity Investment with Demand Learning

Anyan Qi, University of Michigan, 701 Tappan St. R4421, Ann Arbor, MI, 48109, United States of America, anyqi@umich.edu, Hyun-Soo Ahn, Amitabh Sinha

How should a profit-maximizing firm adjust its capacity for a product with a finite life cycle when the market information is incomplete but can be learned? We characterize the firm's optimal policy about when and by how much to adjust the capacity in a multi-period model. To evaluate the performance of this policy, we derive bounds of the firm's value-to-go function using heuristics, show the optimal policy asymptotically converges to the upper bound, and characterize the rate of convergence.

4 - Dynamic Bargaining in a Supply Chain with Asymmetric Demand Information

Lauren Lu, University of North Carolina, Chapel Hill, NC, United States of America, Lauren_Lu@kenan-flagler.unc.edu, Guoming Lai, Qi Feng

We analyze a dynamic bargaining game between a seller and a buyer, who negotiate over quantity and payment to trade for a product. Both firms are impatient, and they alternate in making a contract offer until an agreement is reached. The buyer is privately informed about his type, which can be either high or low, with respect to the property of the uncertain demand he faces. We find the unique perfect Bayesian equilibrium of the bargaining game.

■ MA45

Level 1 -101E

Advances in Stochastic Models for Chronic Disease Screening and Treatment

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Brian Denton, Associate Professor, University of Michigan, 1205 Beal Avenue, 2893 IOE Building, IOE, Ann Arbor, MI, 48109-2117, United States of America, btdenton@umich.edu

Co-Chair: Yuanhui Zhang, North Carolina State University, Raleigh, NC, 27606, United States of America, yzhang29@ncsu.edu

1 - Optimization of Screening Policies for Newly Discovered Cancer Biomarkers

Christine Barnett, Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, clbarnet@umich.edu, Brian Denton, James Montie, Scott Tomlins, John Wei

Recent advances in the development of new biomarker tests, which physicians use for the early detection of cancer, have the potential to improve patient survival and lower the cost of treatment by catching cancer at an early stage. An optimization model will be discussed for analyzing how to use prostate cancer biomarker tests during screening to maximize quality adjusted survival. Numerical results based on a large clinical dataset will be used to draw insights about optimal screening policies.

2 - Optimal Policies for Arteriovenous Fistula Creation for Patients on Hemodialysis

Skandari Reza, University of British Columbia, 98 West 37th Ave., Vancouver, Canada, reza.skandari@sauder.ubc.ca, Nadia Zalunardo, Steven Shechter

To deliver Hemodialysis (HD), patients need to have a vascular access. The gold standard for delivering HD is via Arteriovenous Fistula (AVF). Due to AVF creation failure, limited lifetime of a functional AVF, and limited places to create an AVF, patients may use an inferior access substitute called Central Venous Catheter (CVC). We characterize conditions under which the patient should or should not be referred for AVF creation, under total lifetime and quality adjusted lifetime metrics.

3 - Optimal Policies for Hepatocellular Carcinoma Surveillance: A Dynamic Approach

Qiushi Chen, Georgia Institute of Technology, H. Milton Steward School of Industrial, 765 Fest Dr., 321 Main Building, Atlanta, GA, 30318, United States of America, chenqiushi0812@gatech.edu, Turgay Ayer, Jagpreet Chhatwal

Surveillance of hepatocellular carcinoma (HCC) among patients with hepatitis C can reduce the burden of disease; however, the optimal screening strategies remain unknown. We develope a mixed-integer programming (MIP)-based approach and evaluate the cost-effectiveness of HCC surveillance policies from the society's perspective. We estimate parameters from clinical studies and provide risk-stratified surveillance policy by disease severity and patient's age.

4 - A Robust Markov Decision Process for Patients with Type 2 Diabetes

Yuanhui Zhang, North Carolina State University, Raleigh, NC, 27606, United States of America, yzhang29@ncsu.edu, Jennifer Mason, Brian Denton, Haipeng Wu, Nilay Shah, Steven Smith, James Wilson

We present a new robust Markov decision process model to optimize treatment decisions for patients with type 2 diabetes in light of uncertainty in model parameters estimated from longitudinal data. We discuss the special structure of the model including properties that can be exploited to achieve computational advantages. Computational results based on a large clinical data set are presented to illustrate the structure and performance of the optimal policy.

■ MA46

Level 1 -101F

Inventory Financing

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Lingxiu Dong, Associate Professor, Washington Universit y, Olin Business School, One Brookings Drive, St. Louis, MO, 63130, United States of America, dong@wustl.edu

Co-Chair: Ankur Goel, Case Western Reserve University, Cleveland, OH, United States of America, axg312@case.edu

Co-Chair: Danko Turcic, Assistant Professor of Operations, Washington University in St., Louis, Olin Business School, St., Louis, MO, 63105, United States of America, turcic@wustl.edu

1 - An Operations-based Model for Predicting Bankruptcy Risk in Retailing

Vishal Gaur, Professor of Operations Management, Johnson School, Cornell University, 321 Sage Hall, Ithaca, NY, 14853, United States of America, vg77@cornell.edu, Yasin Alan

We investigate whether historical operational performance can be a predictor of probability of bankruptcy for U.S. retailers. Focusing on large retail bankruptcies in U.S., we show that inventory productivity and associated operational variables are predictive of bankruptcy probability and improve accuracy of existing bankruptcy prediction models.

2 - The Role of Supply Chain Financing beyond Financing

S. Alex Yang, Assistant Professor, London Business School, Sussex Place, London, NA, United Kingdom, sayang@london.edu, Wenhui Zhao

Supply chain financing, or reverse factoring, is a method that allows the supplier to receive cash from a bank on invoices validated by the buyer. In this talk, we study how supply chain financing can be used as a tool to balance bargaining powers between different supply chain parties and hence potentially improve supply chain efficiency.

3 - VaR Constraint for Newsvendors: Risk Preference Implication and Remedy

Rong Li, Nankai University, 94 Weijin Road, Tianjin, 300071, China, joannali77@gmail.com, Panos Kouvelis

We study a mean profit-maximizing firm who controls profit downside risk using VaR constraint, known to reflect risk aversion. We, however, find that some VaR parameters can imply risk seeking. The firm's risk attitude demands adjusting inventory level downward (risk-averse) or upward (risk-seeking) from risk neutral level. However, such adjustment is no longer needed if demand is correlated with price of a financial asset, as the firm's risk can always be completely counteracted financially.

4 - Integrated Options and Spot Procurement for Commodity Processors

Ankur Goel, Case Western Reserve University, Cleveland, OH, United States of America, axg312@case.edu, Fehmi Tanrisever

We consider a firm that procures a commodity through a combination of options and spot contracts to process it and then distribute it to the downstream retailers to satisfy random demand. We identify conditions under which the options contracts are more valuable than the forward contracts for the firm. We show that the value of procurement through options contract increases with demand volatility and decreases with price volatility.

5 - Push, Pull, and Trade Credit Contracts in Competitive Markets

Lingxiu Dong, Associate Professor, Washington University, Olin Business School, One Brookings Drive, St. Louis, MO, 63130, United States of America, dong@wustl.edu, Danko Turcic, Xiaomeng Guo

We consider the use of three basic wholesale price contracts, push, pull, and trade credit, in a competitive retail environment. The research focuses on understanding the implications of product offerings and downstream retail competition for the supply chain's equilibrium contract.

■ MA47

Level 1 -101G

Managing Customer Service Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Ramandeep Randhawa, University of Southern California, Marshall School of Business, Los Angeles, CA, United States of America, Ramandeep.Randhawa@marshall.usc.edu

Co-Chair: Achal Bassamboo, Northwestern University, Kellogg School of Management, Evanston, IL, United States of America, a-bassamboo@kellogg.northwestern.edu

1 - Staffing Customer Service Web Chat Systems with General Service and Abandonment Times

Tolga Tezcan, University of Rochester, Rochester, NY, United States of America, tolga.tezcan@Simon.Rochester.edu, Jiheng Zhang

We consider web chat service systems with impatient customers where each agent can serve multiple customers at the same time. Customers may abandon from the queue or service. Our objective is to establish the minimum staffing levels required to attain a certain quality of service. We propose approximations for several performance measures when service and patience times have general distributions and formulate a staffing LP to identify effective staffing levels.

2 - Call Center Staffing: Service-level-Differentiation and G-cμ Rules

Seung Bum Soh, Doctoral Student, Northwestern University, 2001 Sheridan Road, Evanston, United States of America, seung-soh@kellogg.northwestern.edu, Itai Gurvich

The prevalence of generalized c-mu rules sheds some light into characteristics of prioritization rules that are considered as desirable. One property of these rules is that they globally differentiate between classes at all time — a VIP customer waits more than a regular customer who arrives at the same time. In this work we show that when solving staffing problems subject to Quality-of-service constraints, generalized c-mu and global differentiation are in important ways equivalent.

3 - Why is Asymptotics-based Optimization in Queueing so Accurate?

Ramandeep Randhawa, University of Southern California, Marshall School of Business, Los Angeles, CA, United States of America, Ramandeep.Randhawa@marshall.usc.edu

In this talk, we prove that the optimality gap of fluid and diffusion approximation methods is much smaller than anticipated. We prove that in many recently studied queueing problems, the difference between the performance of the prescription derived using approximate methods and that of the optimal solution converges to zero as the system scale grows without bound, that is, the approximate prescription is asymptotically exact.

■ MA48

Level 1 -101H

Contracts and Non-Monetary Motivations in Behavioral Operations

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Stephen Leider, University of Michigan, Ross School of Business, 701 Tappan Street R4486, Ann Arbor, MI, United States of America, leider@umich.edu

1 - Understanding the Appeal of Suboptimal Contracts

Anna Devlin, University of Maryland, College Park, MD, United States of America, adevlin@rhsmith.umd.edu, Wedad Elmaghraby, Rebecca Hamilton

In this research, we design an experiment to test behavioral biases driving supplier preferences for economically inferior contracts. The experiment incorporates a two period selling season during which the computerized retailer may sell items on sale. The results indicate subjects are averse to contracts that expose them to retailer effort.

2 - Fairness Ideals in Distribution Channels

Paola Mallucci, University of Wisconsin, Madison, WI, United States of America, mallu004@umn.edu, Tony Haitao Cui

We evaluate how firms make decisions in a two-stage dyadic channel. Using a Quantal Response Equilibrium (QRE) model, we show fairness significantly impacts channel pricing decisions. Additionally, we compare four principles of distributive fairness: strict egalitarian, liberal egalitarian, and libertarian, and a new principle- the sequence-aligned. The new ideal, according to which the sequence of moving determines the equitable payoff, significantly outperforms the other ideals.

3 - Designing Profit-distribution Policies when Fairness Matters

Claudia Marquez-Nava, Instituto Tecnològico de Monterrey, Campus Toluca, Plumbagos 12, Frac. Jardines de Tlacopa, Toluca, Me, 50010, Mexico, clau.marquezn@gmail.com, Kay-Yut Chen, Cipriano Santos

We incorporate distributive fairness in a joint-capacity model, where the perception of fairness can differ between firms. We found that an efficient Nash Equilibrium is only possible when this difference is low. On the other hand, if perceptions of fairness differ greatly, the unique Nash Equilibrium is trivial (zero production). We define the Fairness-Compatibility Index as a means to determine the nature of the Nash Equilibrium. This index is useful to predict partnership's failure.

4 - The Holdup Problem in Supply Chains

Stephen Leider, University of Michigan, Ross School of Business, 701 Tappan Street R4486, Ann Arbor, MI, United States of America, leider@umich.edu, Andrew Davis

We study the holdup problem for capacity investment in a two-stage supply chain with random demand and structured bargaining. After evaluating five different contracts, we find that an option contract mitigates the holdup problem by achieving higher investment levels. Other contracts (such as a quantity price premium or a quantity commitment), while theoretically able to yield first-best investment levels, yield smaller improvements.

■ MA49

Level 1 -101I

Advances in Risk-Averse Optimization

Cluster: Tutorials

Invited Session

Chair: Andrzej Ruszczynski, Rutgers University, Department of Management Science, 94 Rockafellar Road, Piscataway, NJ, 08854, United States of America, rusz@business.rutgers.edu

1 - Advances in Risk-averse Optimization

Andrzej Ruszczynski, Rutgers University, Department of Management Science, 94 Rockafellar Road, Piscataway, NJ, 08854, United States of America, rusz@business.rutgers.edu

We discuss main ideas of formalizing risk-averse preferences and using them in optimization problems: utility theories, risk measures, and stochastic order constraints. We also present methods for solving risk-averse optimization problems. Multistage risk-averse models will be discussed as well, in particular, time-consistency and decomposition.

■ MA50

Level 1 -101J

Impacts of Climate Change on the Automotive Industry

Cluster: Climate Change and OR

Invited Session

Chair: Erica Klampfl, Technical Leader, Ford Motor Company, 2101 Village Road, Dearborn, MI, United States of America, eklampfl@ford.com

1 - Investment Strategy for Automakers and Electricity Generators in a Carbon Constrained World

Boxiao Chen, PhD Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, boxchen@umich.edu, Erica Klampfl, Margaret Strumolo, Michael Tamor

Greenhouse gas emission targets are becoming increasingly more stringent over time for automakers and electricity generators, requiring technology and capacity planning strategies that are both environmentally friendly and cost efficient. With the introduction of plug in hybrid and electric vehicles, these two sectors are linked. We present a LP that enables tradeoff analysis between the sectors if they work independently with separate emission constraints or together with a joint constraint.

2 - Global Energy Transition (GET) Model: Informing Vehicle Technologies in a Decarbonized Economy

Maria Grahn, Chalmers University of Technology, Dept of Energy and Environment, Physical Resource Theory, Gothenburg, 41296, Sweden, maria.grahn@chalmers.se, Timothy J Wallington, Erica Klampfl, Margaret Strumolo

The GET model is an LP that generates the fuel and technology mix that meets global energy demands at lowest energy system costs. We assess how uncertainty in future vehicle technology costs and developments in other energy sectors affect cost-effective fuel and vehicle technology choices in a future carbon constrained world. We conclude that a portfolio approach of multiple fuel and vehicle technology pathways is ideal for achieving affordable and sustainable personal mobility.

3 - Life Cycle Cost and GHG Emissions of Electric Vehicle Fast Charging and Battery Swapping Stations

Jeremy Michalek, Associate Professor, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, jmichalek@cmu.edu, Chris Hendrickson, Elizabeth Traut

We examine scenarios for fast charging and battery swapping for battery electric vehicles at service stations along a highway. We construct infrastructure life cycle cost and greenhouse gas emissions models, including operation (queuing) models for equipment and battery inventory requirements. We find that direct costs of fast charging are lower, but including the value of waiting time during service makes battery swapping less costly provided that vehicles and batteries are standardized.

4 - Consumer Preferences for Hybrid and Electric Vehicles in China and the United States

John Helveston, PhD Student, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15231, United States of America, jhelvy@andrew.cmu.edu, Elea Feit, Jeremy Michalek, Yimin Liu, Erica Klampfl, Erica Fuchs

We model consumer preferences for EVs in both China and the U.S. using data from choice-based conjoint surveys. We find U.S. consumer willingness-to-pay (WTP) for battery electric vehicles (BEVs) is $13,000–$17,000 lower than conventional vehicles (CVs) with identical attributes, while Chinese WTP is within $2,000. Current U.S. subsidies are sufficient to drive mainstream adoption of plug-in hybrid electric vehicles (PHEVs) and insufficient for BEVs; current Chinese subsidies imply the opposite.

■ MA51

Level 1 -102D

Flexible Multimodal Transport Systems

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Joseph Chow, Assistant Professor, Ryerson University, 350 Victoria Street, Toronto, ON, M5B 2K3, Canada, joseph.chow@ryerson.ca

1 - An Integrated Approach to Improve Bike Sharing Rebalancing Operations

Robert Regue, PhD Candidate, University of California, Irvine, Institute of Transportation Studies, 4000 Anteater Instruction and Research B, Irvine, CA, 92617, United States of America, rreguegr@uci.edu, Will Recker

Daily rebalancing operations in Bike Sharing systems are required to deliver a good level of service. The proposed approach first determines optimal inventory ranges based on historical data. Secondly, future inventory levels are forecasted using machine-learning techniques at three different time steps and optimal pickups and drop offs are computed solving a linear integer problem. Finally, a vehicle routing problem is solved in a rolling horizon fashion to determine optimal vehicle routes.

2 - Operations and Algorithms of a Real-time Shared Ride System

R. (Jay) Jayakrishnan, Professor, University of California, Irvine, Institute of Transportation Studies, University of California, Irvine, Irvine, CA, 92697, United States of America, rjayakri@uci.edu, Jaeyoung Jung

High Coverage Point-to-Point Transit (HCPPT) is an alternative design for mass passenger transport with real-time shared rides. It ensures that no passenger has more than one transfer and involves transfer hubs, trunk routes between hubs with semi-flexible vehicle re-routing, and local rerouting around hubs. A decomposed optimization is used, with detailed rules for vehicle selection and routing. Optimization and simulation frameworks are discussed, with consideration of global optimality.

3 - Bike Sharing with Multi-period Schedule Delay within Host Transit Network

Hamidreza Sabarshad, Ryerson University, 87 Steeles Ave. East, Toronto, ON, 2M2 3Y4, Canada, hsabarsh@ryerson.ca, Joseph Chow

A multi-periodic optimization is formulated to design a bike-sharing system for travel as a means to extend public transport for access and egress trips. The model is applied to evaluate existing bike sharing system designs such as the BIXI system in Toronto to gain greater insight to its impact on public transport ridership.

4 - Agent based Model for Dynamic Ridesharing

Matthew Roorda, Associate Professor, University of Toronto, Department of Civil Engineering, University of Toronto, Toronto, On, M5S 1A4, Canada, roordam@ecf.utoronto.ca, Mehdi Nourinejad

Dynamic ridesharing brings together individuals with similar itineraries to travel together and share the costs. Centralized (binary integer programming) and decentralized (dynamic auction-based multi-agent) optimization algorithms are formulated to match passengers and drivers. An application of these methods on a large scale case study shows that the decentralized approach provides near optimal solutions for single-driver, single-passenger case, with much less computational burden.

■ MA52

Level 1 -102E

Scheduling Problems in Transportation Systems

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Evangelos Kaisar, Associate Professor, Florida Atlantic University, 777 Glades Rd.Bldg. #36, Boca Raton, FL, 33431, United States of America, ekaisar@fau.edu

1 - A Combined Scheduling Transportation Problem

Johan Oppen, Associate Professor, Molde University College, Specialized University in Logistics, P O Box 2110, Molde, 6402, Norway, johan.oppen@himolde.no, Markus Brachner

We present a real-world planning problem that occur, for example, in the construction industry. Given a number of jobs or projects, each with a known location, estimated duration and demand of materials, the problem is to assign projects to teams of workers, schedule the projects for each team, and construct a transportation plan for how to supply the projects with the needed materials. Modeling and solution approaches are discussed.

2 - A Multiprocessor Container Port Scheduling Model with Time Windows (MCPSTW)

Ghazal Assadipour, PhD Student, Memorial University of Newfoundland, 4017, 216 Prince Philip Drive, FeildHall, St. John's, NL, A1B3R5, Canada, ghazal.assadipour@mun.ca, Manish Verma, Ginger Ke

This research studies the sequencing of quay and yard cranes to minimize the total weighted completion time of unloading and loading containers at a terminal. A mixed integer programming model is developed in considering multiple processers (cranes), each with its individual time windows, in the two stages. A meta-heuristic approach is designed and implemented to solve the proposed model. Detailed computational tests illustrate the applicability and effectiveness of this study.

3 - Transportation Network Design for Tourism Development

Yun Bai, University of Illinois, Champaign, IL, United States of America, yunbai1@illinois.edu

This study proposes an integrated bi-level optimization model to jointly address tourism planning (i.e., investment site choice) and network design of the supporting transportation infrastructure. The upper-level objective minimizes the total system cost while the lower-level captures user equilibrium for both tourists and non-tourists under traffic congestion. A customized solution approach is developed via reformulation and approximation, and then illustrated through an empirical case study.

■ MA54

Level 1 -103A

Advances in V2V and V2I Modeling II: Applications

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Anuj Sharma, Assistant Professor, University of Nebraska Lincoln, 330 F Whittier Building, Lincoln, NE, 68583, United States of America, asharma3@unl.edu

1 - Investigation of a Hybrid Route Guidance Strategy for Traffic Management under Vehicle-to-Vehicle Communications

Yong Hoon Kim, Graduate student, Purdue University, 3000 Kent ave., West Lafayette, IN, 47906, United States of America, kim523@purdue.edu, Srinivas Peeta

This study proposes a hybrid route guidance strategy under a centralized traffic control system with fully decentralized Vehicle-to-Vehicle communications (V2V). The proposed model seeks to leverage centralized proactive route guidance and local information available through V2V communications. Numerical experiments are illustrated to demonstrate the efficiency of the proposed approach and derive insights using simulated field data.

2 - Using Combinatorial Auction and V2I Communication to Efficiently Allocate Road Resources

Hao Zhou, University of Michigan, Ann Arbor, MI, United States of America, haozhou@umich.edu

We use Vehicle-to-Infrastructure (V2I) devices to implement a Vickrey-Clarke-Groves (VCG) type auction to reduce congestion in a traffic network. Each vehicle need to provide their willingness-to-pay information before entering the network. Based on these information, the central controller assign a path to each vehicle, and collect toll payment from this vehicle. Our auction mechanism guarantees that 1) each vehicle report their willingness-to-pay truthfully, and 2) the overall utility of vehicles are optimized.

3 - Vehicle to Infrastructure Communication Based Yellow Onset Decision Assistance System

Anuj Sharma, Assistant Professor, University of Nebraska Lincoln, 330 F Whittier Building, Lincoln, NE, 68583, United States of America, asharma3@unl.edu, Sepi Aria, Liu Chenhui

The effect of information systems on the probability of conflict at onset yellow at high-speed intersections will be discussed. This results were used to develop a prototype Yellow Onset Driver Assistance (YODA) system using COTS hardware. The prototype design insights, challenges and future directions will be presented.

4 - Travel Time Transmission Model: A New Dynamic Traffic Assignment Model for Connected Vehicle Data

Peter Jin, University of Texas-Austin, Austin, TX, United States of America, jjin@austin.utexas.edu, Stephen Boyles

In this study, a new dynamic traffic assignment model, travel time transmission (TTM) model, is proposed based on the Lagrangian-space traffic flow model. The proposed model preserves both the link-cell representation from the space-time CTM model and the numerical and formulation benefits of the Lagrangian models. Mobile sensor data collected by probe vehicles and future connected vehicles can be easily plugged into the TTM model efficiently.

■ MA55

Level 1 -103B

Disaster Preparedness and Management

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Reza Faturechi, University of Maryland, 1173 Glenn L. Martin Hall, University of Maryland, College Park, MD, 20742, United States of America, reza@umd.edu

1 - A Literature Survey: An All-hazards Approach to Disaster Management Planning

Josey Chacko, Virginia Tech, 412 W Redwood Street, Baltimore, MD, 21201, United States of America, joseyc@vt.edu

An exhaustive literature review of various quantitative models in the All-Hazards (AH) disaster management planning literature will be evaluated, highlighting the current gaps in this field.

2 - Pre-disaster Investment Decisions for China Railway Network under Flood Hazards

Liu Hong, Associate Professor, Huazhong University of Science and Technology, 1037#, Luoyu Road, Institute of System Engineering, Wuhan, HB, 430074, China, liu.hong@hust.edu.cn, Min Ouyang, Srinivas Peeta, Zhezhe Pan

We address a pre-disaster planning problem seeks to select and prioritize links in China Railway Network to strengthen under a limited budget with the objective of maximizing the post-flood performance. A recursive decomposition algorithm is used to calculate the connectivity between stations based on link failure probabilities obtained through historical flood hazards and rail link flood damage data. Numerical experiments illustrate the tractability and effectiveness of the proposed method.

3 - A Comprehensive Review of the Literature on Disaster Performance Analysis of Transportation Systems

Reza Faturechi, University of Maryland, 1173 Glenn L. Martin Hall, University of Maryland, College Park, MD, 20742, United States of America, reza@umd.edu, Elise Miller-Hooks

This talk provides a comprehensive review of the literature on transportation system performance in disaster. Performance characteristics considered include risk, vulnerability, reliability, robustness, flexibility, survivability and resilience. The works are classified based on a host of criteria, including applied measure (qualitiative vs. quantitative, assessment vs. management), conceptual approach, and methodology.

■ MA56

Level 1 -103C

Applications of Parallel Computing in Energy Systems Planning and Operations (Part I)

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Anthony Papavasiliou, Assistant Professor, Catholic University of Louvain, Voie du Roman Pays 34, Office b.114, Louvain la Neuve, 1348, Belgium, anthony.papavasiliou@gmail.com

1 - Applying High Performance Computing to Multi-area Stochastic Unit Commitment

Anthony Papavasiliou, Assistant Professor, Catholic University of Louvain, Voie du Roman Pays 34, Office b.114, Louvain la Neuve, 1348, Belgium, anthony.papavasiliou@gmail.com, Shmuel Oren

We present a parallel implementation of Lagrangian relaxation for solving stochastic unit commitment subject to wind supply uncertainty and component failures. We present a scenario selection algorithm inspired by importance sampling and validate its performance by comparing it to a stochastic formulation with a very large number of scenarios. We examine the impact of narrowing the duality gap on performance and running time and compare it to the impact of increasing the number of scenarios.

2 - Parallel Risk Averse Computational Stochastic Programming: Storage Operation Case

Somayeh Moazeni, Princeton University, Princeton, NJ, United States of America, somayeh@Princeton.EDU, Warren Powell, Belgacem Bouzaiene-Ayari

In this talk we present a novel risk averse computational stochastic programming approach, called "SMART-PPS"for multi-stage finite horizon optimization problems under stochastic uncertainty and risk. The methodology relies on policy search, spline approximation, and a direct search framework. We describe a parallel implementation of this approach using a nested parallel model. The tractability and performance of the methodology are discussed for an energy storage optimal operation problem.

3 - Stochastic Unit Commitment: Scalable Computation and Experimental Results

Jean-Paul Watson, Sandia National Laboratories, PO Box 5800, MS 1326, ALbuquerque, NM, 87185-1326, United States of America, jwatson@sandia.gov, David Woodruff, Sarah Ryan

We describe an ARPA-e project addressing stochastic unit commitment. The problem is to optimize day-ahead and intra-day electricity generation taking into account load and renewable uncertainty. We solve the problem using scenario-based decomposition techniques and modest parallel computing resources. Our solver is embedded in a stochastic simulation environment, to validate the model and to quantify cost savings. We describe experimental results for WECC, ISO-NE, and FERC test cases.

4 - Bounding and Decomposition for Transmission and Generation Planning with Intermittent Resources

Francisco Munoz, Ph.D., The Johns Hopkins University, Baltimore, MD, United States of America, francisco.munoz@jhu.edu, Ben Hobbs

We propose a two phase approach to solve large-scale grid planning problems with intermittent generation. Phase one is a bounding approach based on Jensen's inequality and Monte Carlo importance sampling, while Phase two is an enhanced Benders decomposition. We improve the convergence of Benders decomposition by including an auxiliary lower bound in the master problem from phase one. Our method is applied to the 240-bus WECC system and tested in both single and parallel computer systems.

■ MA57

Level 1 -103D

Energy Market Models I

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Steven Gabriel, University of Maryland, College Park, MD, United States of America, sgabriel@umd.edu

1 - Endogenous Shifts in OPEC Market Power — A Stackelberg Oligopoly with Fringe

Daniel Huppmann, PhD Candidate, DIW Berlin (German Institute for Economic Research), Mohrenstrafle 58, Berlin, 10117, Germany, dhuppmann@diw.de

I proposes a two-stage oligopoly model for the crude oil market. In a game of several Stackelberg leaders, market power increases endogenously as the spare capacity of the competitive fringe goes down. I discuss how most large-scale numerical equilibrium models applied in the energy sector over-simplify and misinterpret market power exertion. Furthermore, I show that this two-stage model can be solved numerically as a MCP with heterogeneous firms and discuss uniqueness of equilibrium.

2 - LNG Capacity Requirement in the Global Gas Market using the World Gas Model

Seksun Moryadee, PhD Candidate, University of Maryland, College Park, MD, United States of America, smoryade@umd.edu, Steven Gabriel

In this presentation we analyze optimal future LNG capacity requirements, including regasification and liquefaction capacity. In particular, this research looks at how development of growing demands and emergence of unconventional production will influence global LNG markets and future capacity requirements.

3 - Accuracies of Optimal Transmission Switching (OTS) Heuristics based on DCOPF and ACOPF

David Fuller, Professor, University of Waterloo, Department of Management Sciences, Waterloo, ON, N2L 3G1, Canada, dfuller@uwaterloo.ca, Milad Soroush

OTS models and heuristics have relied on the DCOPF approximation. We show, with a test system, that this can give poor choices for line removals, if cost reduction is estimated using the exact ACOPF. We extend a line ranking idea that was derived from the DCOPF, to a more general method based on the ACOPF, and we show that the line rankings are better than those based on the DCOPF, for the test system. We modify an OTS heuristic to use the ACOPF-based line rankings.

■ MA58

Level 1 -103E

Forestry Supply Chains and Industrial Management

Sponsor: Energy, Natural Res & the Environment/Forestry/Mining

Sponsored Session

Chair: Erin Belval, Colorado State University, Campus Delivery 1472, Fort Collins, CO, 80523, United States of America, mccowene@gmail.com

1 - Value Chain-based Accounting Approach for Decision Making: Applications to Sawmills

Marc-Andre Carle, Research Fellow, Université Laval, 1065, Av. de la Médecine, Quebec, QC, G1V0A6, Canada, marc-andre.carle@forac.ulaval.ca, Damien Chauvin, Sophie D'Amours, Mikael Ronnqvist

Fixed and variable costs used in supply chain management decision models are often based on approximations. Activity-based costing (ABC) methods allow decision makers to distribute indirect costs on activities and products. However, application of ABC to divergent production systems remains challenging for many reasons. This talk will present a methodology to apply ABC methods in divergent production systems. This methodology is validated using two case studies from the sawmilling industry.

2 - Strategic Planning of Forest Management and Industrial Capacity Needs Spatial Models

Eldon Gunn, Professor, Dalhousie University, Dept. Industrial Engineering, 5269 Morris St., Halifax, NS, B3H 4R2, Canada, eldon.gunn@dal.ca, Narges Sereshti, Andrew Martin, Evelyn Richards

The major strategies in forest management are based on spatial concepts. These involve biodiversity, ecodistricts, watersheds, old growth and other protected areas. They also involve transportation and relative location of mills to the forest harvest and to each other. In this paper we report on large scale modelling approaches that can accommodate a diversity of spatial constraints and location decisions. We report some numerical results.

■ MA59

Level 1 -103F

Models for Public Charging Infrastructure System of Plug-in Electric Vehicles

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Yongxi Huang, Clemson University, 314 Lowry Hall, Clemson, SC, 29634, United States of America, yxhuang@clemson.edu

1 - Optimal Prices of Electricity at Public Charging Stations for Plug-in Electric Vehicles

Fang He, University of Florida, 511 Weil Hall, Gainesville, FL, 32611, United States of America, jayhe@ufl.edu, Yafeng Yin, Jianhui Wang

With an increasing deployment of plug-in electric vehicles, evaluating and mitigating the impacts of additional electrical loads created by these vehicles on power distribution grids become more important. This research explores the use of prices of electricity at public charging stations as an instrument, in couple of road pricing, to better manage both power distribution and urban transportation networks.

2 - A Mathematical Model for Evaluating the System Impact of EV Demand

Yueyue Fan, Associate Professor, University of California-Davis, One Shield Ave., Davis, CA, United States of America, yyfan@ucdavis.edu

In this talk, we will present a network model that captures the spatial interdependence of existing power supply and demand. This model will be used to evaluate the economic and environmental impacts of increasing EV demand in a California case study.

3 - Optimally Locating Charging Stations for Serving Plug-in Electric Vehicular Flows

Nan Jiang, University of Texas Austin, Austin, TX, United States of America, jiang@utexas.edu, Chi Xie

An optimal location problem of where to build public charging stations for plug-in electric vehicles (PEVs) in an equilibrium network is formulated and solved. The model is of a bi-level structure, with its upper level minimizing the network-wide travel cost subject to the budget constraint and its lower level characterizing PEV driver's route choice behavior shaped by the en-route charging requirement. A nested partition method is implemented and evaluated for solving the problem.

4 - An Optimization Model for Location of Public Charging Stations for Plug-in Electric Vehicles

Yongxi Huang, Clemson University, 314 Lowry Hall, Clemson, SC, 29634, United States of America, yxhuang@clemson.edu, Shengyin Li

We formulated a multi-path station location model as a flow-based set covering location model to optimize a deployment of PEV public charging stations on a transportation network. The model was implemented in two numerical experiments. The results indicate that the charging deployment largely relies on vehicle range, available routing information, and drivers' acceptance of being deviated from pre-planned routes.

■ MA60

Mezzanine - 100A

Data Analytics and Modeling for Healthcare Management II

Sponsor: Data Mining

Sponsored Session

Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, Woolf Hall 420H, 500 West First Street, Arlington, TX, 76019, United States of America, shouyisxty@gmail.com

Co-Chair: Gianluca Gazzola, PhD Student, Rutgers University, Piscataway, NJ, 08854, United States of America, ggazzola@rci.rutgers.edu

1 - Machine-learning Functional Connectivity Analysis for the Prediction of Mild Cognitive Impairment

Gianluca Gazzola, PhD Student, Rutgers University, Piscataway, NJ, 08854, United States of America, ggazzola@rci.rutgers.edu, Thomas Grabowski, Paul Borghesani, Art Chaovalitwongse, Myong K Jeong

We introduce an fMRI data classification framework for the prediction of mild cognitive impairment. We extract an array of novel features from resting-state brain activity to characterize functional associations within and between regions of interest. We PCA-transform and select features to train a Linear Discriminant Analysis classifier. We validate our technique on a data set from the Seattle Longitudinal Study, obtaining accurate predictions for more than 90% of the subjects.

2 - Predicting the Clinical Outcome in Patients with Traumatic Brain Injury using Clinical Pathway Score

Monica Puertas, University of South Florida, 18125 Birdwater Dr., Tampa, FL, 33647, United States of America, mpuertas@mail.usf.edu, Peter Fabri, Jose Luis Zayas-Castro, Jennifer Mendoza-Alonzo

The Veterans Affairs Hospital treats patients with Traumatic Brain Injuries. These patients have major motor and cognitive disabilities. The progress is assessed using Functional Independence Measures and Clinical Pathway. This work develops a clinical outcome predictive model. The results will allow healthcare providers to improve the current resource management, as well as to provide the family more accurate and timely information about the status and needs of the patient.

3 - Emergency Medical Service Facilities Location with Service Level Constraints on Priority Class

Sachin Jayaswal, Assistant Professor, Indian Institute of Management, Vastrapur, Ahmedabad, Gu, 380015, India, sachin@iimahd.ernet.in, Navneet Vidryarthi

We present a location-allocation model for Emergency Medical Service facilities under constraint on the waiting time distribution for each priority patient class. We solve this problem by exploiting the concavity of the waiting time distribution of low priority customers to eliminate its non-linearity at the expense of a large number of tangent hyperplanes, determined numerically using Matrix Geometric Method.

■ MA61

Mezzanine - 100B

Data Mining Topics I

Sponsor: Data Mining

Sponsored Session

Chair: Haibing Lu, Assistant Professor, Santa Clara University, 500 El Camino Real, Leavey School of Business, Santa Clara, CA, 95053, United States of America, hlu@scu.edu

1 - Effective Compression, Clustering, and Pattern Discovery for Binary Data Sets

Haibing Lu, Assistant Professor, Santa Clara University, 500 El Camino Real, Leavey School of Business, Santa Clara, CA, 95053, United States of America, hlu@scu.edu

This paper presents a framework for effective compression, clustering, and pattern discovery for binary datasets, using weighted rank-one binary matrix factorization.

2 - A Two-stage Algorithm to Herbert-Stevens Model: From a Monocentric to a Duocentric City

Haoying Wang, PhD Candidate, The Pennsylvania State University, 106 Armsby Bldg, University Park, PA, 16802-5600, United States of America, halking@psu.edu

I revisit Wheaton (1974)'s revised Herbert-Stevens model and propose a new two-stage algorithm to the problem. Using an example based on monocentric city framework I demonstrate that the determination of optimal net return to land in the first stage can be converted into a constrained NLP problem, which is feasible to be efficiently solved by Frank-Wolfe algorithm. The algorithm is then applied to a more complex duocentric city framework. The results show that the new algorithm works well.

3 - Combination of Supervised and Unsupervised Segmentation of Pubis for Diagnosis of Pelvic Organ Prolapse

Sinan Onal, Doctoral Candidate, University of South Florida, 4200 E. Fowler Ave., ENB 118, Tampa, FL, 33617, United States of America, sonal@mail.usf.edu, Susana Lai-Yuen, Paul Bao, Alfredo Weitzenfeld, Stuart Hart

Pelvic Organ Prolapse (POP) is a major health problem affecting up to 30-50 percent of women.Diagnosis of POP through dynamic MRI has become popular due to inaccuracies of clinical examination.We present a new segmentation approach for automating pelvic bone point identification on MRI using a multi-stage mechanism based on the texture-based block classification and K-means clustering analysis to diagnose POP on MRI.

■ MA62

Mezzanine - 100C

2013 QSR Best Student Paper Competition

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Tirthankar Dasgupta, Harvard University, 1 Oxford St., Dept of Statistics, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu

1 - Best Student Paper Award

Tirthankar Dasgupta, Harvard University, 1 Oxford St., Dept of Statistics, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu

Abstract: Best Student Paper Award recognizes excellence among QSR student members. Four finalists for the Best Student Paper Award will be selected to make presentations. The winner will be announced at the QSR business meeting during the conference.

2 - A Run-to-Run Controller for Product Surface Quality Improvement

Lulu Bao, PhD Candidate, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, baoll11@mails.tsinghua.edu.cn, Kaibo Wang

The surface quality of silicon wafers has a great impact on the subsequent processes. The geometric requirement for the wafer surface is smooth and flat; the thickness is expected to fall within certain specification limits. To achieve the requirement through control, we build a Gaussian-Kriging model, considering the spatial correlation of observations on the wafer, to link the wafer quality with the process variable, and then develop a new run-to-run controller to generate the optimal recipe.

3 - Bayesian Site Selection for Gaussian Process Regression

Arash Pourhabib, Research Assistant, Texas A&M University, TAMU 3131, College Station, TX, 77840, United States of America, arash.pourhabib@tamu.edu, Yu Ding, Faming Liang

One major difficulty attributed to Gaussian Process (GP) regression is its computational complexity. We propose a Bayesian Site Selection (BSS) method to approximate GP through utilizing latent variables. The BSS is then solved using reversible jump MCMC methods. The BSS provides accurate prediction while spending reasonable computation time.

4 - Indicator Functions and the Algebra of the Linear-quadratic Parametrization

Arman Sabaaghi, Harvard University, Cambridge, MA, United States of America, C.F. Jeff Wu, Tirthankar Dasgupta

Indicator functions are constructed under the linear-quadratic parametrization of contrasts, and applied to study partial aliasing for three-level fractional factorials. Algebraic operations are introduced to simplify calculation of indicator coefficients. These operations connect design constructions to analyses under the linear-quadratic system, and establish conditions for estimable interactions.

5 - Monitoring Wafer Geometric Quality using Additive Gaussian Process Model

Linmiao Zhang, National University of Singapore, 1 Engineering Drive 2, Singapore, Singapore, a0089309@nus.edu.sg, Nan Chen, Kaibo Wang

Monitoring wafer geometric quality in semiconductor manufacturing is difficult due to complex data structures. In this article, we propose an additive Gaussian process (AGP) model to approximate standard geometric quality profile and to quantify the profile deviations when the process is in control. Based on the AGP model, we further develop two statistical tests to monitor the wafer geometric quality.

■ MA63

Mezzanine - 100D

Degradation Modeling under Dynamic Environments and Preventive Maintenance I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Xiao Liu, Research Staff Member, IBM Research Collaboratory Singapore, 9 CBP 1, The IBM Place, Singapore, 486048, Singapore, liuxiao@sg.ibm.com

1 - Periodic Inspection Optimization for Infrastructure Systems Subject to Hidden Failures

Dzung Phan, IBM T.J. Watson Research Center, Yorktown Heights, NY, United States of America, phandu@us.ibm.com, Jayant Kalagnanam, Yada Zhu

A method for finding the periodic inspection interval for geo-distributed infrastructure systems subject to hidden failures is presented. We cluster the units of a system into groups, then calculate the optimal inspection interval for each group based on the expected cost per cycle. Finally, we determine the schedule for inspection by minimizing the total inspection cost subject to the labor and budget constraints. An integer nonlinear programming formulation and a heuristics are developed.

2 - Reliability Analysis for Failure Processes under Degradation-Dependent Hard Failure Threshold

Koosha Rafiee, University of Houston, Houston, TX, United States of America, koosha.rafiee@gmail.com, Qianmei Feng, David Coit

We introduce reliability models for a device with two dependent failure processes: soft failure due to degradation, and hard failure due to random shocks, by considering the declining hard failure threshold according to changes in degradation. Due to the nature of degradation for complex devices such as Micro-Electro-Mechanical Systems (MEMS), a degraded system is more vulnerable to force and stress during operation.

3 - Degradation Modeling and Remaining Useful Life Prediction of Li-Ion Batteries

Nan Chen, Assistant Professor, National University of Singapore, 1 Engineering Drive 2, Singapore, 129789, Singapore, isecn@nus.edu.sg

The increasing demands on green energy source have significantly pushed the application and development of Li-Ion batteries forward. To accomondate their wide applications, it is also necessary to accurately model their degradation and predict their remaining useful lives (RUL). In this article, we proposed a varying coefficient model to indirectly characterize the battery capacity degradation from its discharging profiles.

■ MA64

Mezzanine - 100E

Maintenance Optimization

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Lisa Maillart, Associate Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, maillart@pitt.edu

Co-Chair: Jeffrey Kharoufeh, Associate Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, jkharouf@pitt.edu

1 - Scheduling Preventive Maintenance as a Function of an Imperfect Inspection Interval

Kai He, Ph.D. student, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, sjtu.hekai@gmail.com, Lisa Maillart, Oleg Prokopyev

We present an imperfect inspection and preventive maintenance (PM) model for a system subject to hidden failures. Inspections occur at fixed intervals and detect failures with a known probability. PM renews the system at failure detection or at a scheduled time. The objective is to schedule PM as a function of the inspection interval to minimize the expected long-run cost rate. Analytical and numerical results illustrate conditions that ensure the existence of an optimal solution.

2 - Optimal Maintenance Policies for a Safety-Critical System and its Deteriorating Sensor

Chiel van Oosterom, PhD Student, Eindhoven University of Technology, PO Box 513, Eindhoven, 5600MB, Netherlands, C.D.v.Oosterom@tue.nl, Lisa Maillart, Jeffrey Kharoufeh, Hao Peng

We formulate a partially observable Markov decision process (POMDP) model for the integrated problem of optimally maintaining a deteriorating sensor and the safety-critical system it monitors. The sensor's imperfect observations on the state of the system become less informative as the sensor ages. The system state can be identified perfectly by a costly site visit, which also provides an opportunity to replace the sensor.

3 - Information Acquisition on Technology Evolution for Maintenance and Replacement Optimization

Thomas Yeung, Associate Professor, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, BP 20722, Nantes, 44307, France, thomas.yeung@mines-nantes.fr, Khanh Nguyen, Bruno Castanier

Uncertain technology evolution strongly impacts asset replacement decisions as there is risk in replacing too early or too late. Further, maintenance allows more time to wait for future technology and risk can be mitigated by obtaining information on future technology. We incorporate information acquisition decisions into a non-stationary Markov decision process for maintenance optimization. We provide analytical properties on the optimal policy and illustrate them through numerical examples.

4 - Optimal Equipment Replacement for a Markov Additive Process with Brownian Noise and Jumps

Nazanin Esmaili, PhD Student, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, nae22@pitt.edu, Lisa Maillart, Jeffrey Kharoufeh

We consider the optimal maintenance of a stochastically degrading system to minimize the total expected discounted cost of preventive and reactive replacements over an infinite planning horizon. The degradation is modeled as a Markov additive process superimposed with Brownian noise and jumps at known, deterministic intervals. Using an MDP model, we prove the optimality of a threshold policy for each environment state and show that the discounted cost is non-decreasing in the degradation level.

■ MA65

Mezzanine - 100F

Business Process Intelligence

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Zhe (Jay) Shan, Assistant Professor, University of Cincinnati, 2925 Campus Green Dr. Rm 509, Cincinnati, OH, 45221, United States of America, zhe.shan@uc.edu

1 - Optimizing Complex Decisions through Flexible Business Processes Management and Provenance

Roman Vaculin, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, United States of America, vaculin@us.ibm.com

We present a framework for support of complex collaborative decision processes, such as team development project planning or acquisition, that integrates flexible declarative business process management techniques, human generated insights and analytics based insights. The approach enables insights into and optimization of complex collaborative decisions through the decision provenance and business process intelligence techniques, such as querying and mining of the provenance graphs and records.

2 - Evaluating and Innovating Business Process Coordination (BPC): The Role of Analytics

Paul C. van Fenema, Netherlands Defence Academy, Hogeschoollaan 2, Breda, Netherlands, pc.v.fenema@nlda.nl

Business process coordination drives value generated by business processes. Increasingly, stakeholders get interested in the impact of BPC on the extent to which these processes generate value for them. The objective of this conceptual study is to develop a model for understanding the impact of BPC on the value generated by business processes. Drawing on analytics research, we conceptualize and relate stakeholder expectations, business process (performance), and ostensive and performative BPC.

3 - Improve IT Incident Handling Based on SME Social Network Information

Zhe (Jay) Shan, Assistant Professor, University of Cincinnati, 2925 Campus Green Dr. Rm 509, Cincinnati, OH, 45221, United States of America, zhe.shan@uc.edu, Rong Liu

Due to the complexity of IT environment, the IT incident diagnosis at application level is very challenging. The traditional sequential approach leads huge cost of handling delay. In this paper, we propose to use the historical communication information among SMEs to identify their social network structure. Based on this network, we can identify an appropriate expert group for different kinds of incidents, which potentially improves the efficiency of incident handling.

■ MA66

Mezzanine - 100G

Social Media and Business Applications

Sponsor: Information Systems

Sponsored Session

Chair: Lucy Yan, Assistant Professor, Indiana University, Kelley School of Business, Business 570C, Bloomington, In, 47401, United States of America, yanlucy@indiana.edu

1 - The Effects of In-App Purchase and New Introduction of Mobile Apps: Freemium vs. Paid

Young Jin Lee, Assistant Professor, University of Denver, 2101 S. University Blvd., Denver, CO, 80208, United States of America, youngjinlee@gmail.com

There are two types of commercial mobile apps; freemium app and paid app. We study how In-app purchase and new introduction of the apps to an App Store ranking system can affect their long term performance in the App Store. Using app rank data in the Apple App Store in 2011, we found that freemium apps can benefit from in-app purchases more than paid apps. Our results also suggest paid apps can improve their performance by new introduction in the App Store.

2 - Understanding the Emotional Content Embedded in Tweets and Impact on Users' Social Structure Change

Ivy Yuan, Indiana University, 503 S. Muller Parkway, Unit 311, Bloomington, IN, 47403, United States of America, yuanl@indiana.edu

Social media platform can be used to exchange personal opinions. For users with depression symptoms, it serves as a convenient way to help them exchange emotional support and maintain social connectivity. This research aims to explore the impact of emotional content in exchanged information on network structure evolvement. The findings of this study can be used to better understand network dynamics and provide insights to help Twitter users getting more emotional support in a more efficient way.

3 - The Impact of Social Capital On Realizing a Trust-based Social Network

Haoyan Sun, PhD Student, University of Washington, Mackenzie 339, Seattle, WA, 98115, United States of America, haoyan@uw.edu, Yong Tan

How to build up trusts has been a central topic of research in social networks. In this paper, we base on social capital theory to investigate what factors can influence an individual's trust network in an online community. Specifically, we propose that an individual's (1)reputation of helpfulness, (2)activeness in the community, and (3)popularity in the network can increase his/her social capital, which will further win him/her trusts from the other network members.

■ MA67

Mezzanine - 100H

Game Theory, Decision Analysis, and Homeland Security

Sponsor: Decision Analysis

Sponsored Session

Chair: Jun Zhuang, Assistant Professor, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, United States of America, jzhuang@buffalo.edu

1 - Modeling Public-private Partnerships in Disaster Management - A Sequential Game with Prospect Utility

Peiqiu Guan, PhD Student, University at Buffalo, 338 Bell Hall, Buffalo, NY, 14260, United States of America, peiqiugu@buffalo.edu, Jun Zhuang

We study optimal public-private partnerships (PPPs) in disaster management using a sequential game where the government is the first mover. We model the risk preferences of the private sector using prospect utilities. We strike to identify (nearly) optimal PPPs when qualitative human behaviors and quantitative risk factors are considered. This paper provides insights on whether, when, and how much investment/subsidy could form a healthy and sustainable PPPS in disaster management.

2 - Robust Multi-stage Screening Strategies in the Face of Strategic Applicants

Cen Song, University at Buffalo, Buffalo, NY, United States of America, censong@buffalo.edu, Jie Xu, Xiaowen Wang, Jun Zhuang

Security check agency could use screening policy to deter adversary but could also lose the benefit from normal application, which generates a tradeoff. This paper studies the optimal security screening policy in an imperfect and N-stage queueing system balancing security and congestion facing strategic applicants. We compare the optimal policies under discriminatory and non-discriminatory screening policies. In addition, we use robust optimization for coping with uncertainties.

3 - Quantifying Adversary Capabilities to Inform Target-hardening Decisions

Chen Wang, University of Wisconsin-Madison, 3239 Mechanical Engineering, Madison, WI, 53706, United States of America, cwang37@wisc.edu, Vicki Bier

We fill a gap in the game-theoretic literature for homeland security by the explicit consideration of adversary capabilities in addition to just intent. We propose a novel Bayesian Stackelberg game to capture the effects of adversary capabilities by using contest success functions from economics. We also allow the effectiveness of attacker capabilities to differ across targets (e.g., civilian vs. military) and attack modes (e.g., attacks using improvised explosive devices vs. nuclear weapons).

4 - Integrating Protection against Intentional Attacks with Facility Location Problem

Chi Zhang, Assistant Professor, Tsinghua University, Department of Industrial Engineering, #1 Qinghua Yuan, Beijing, China, czhang@tsinghua.edu.cn, Jose Emmanuel Ramirez-Marquez

To preserve continued effective performance of facilities, protection against intentional attacks need to be considered while determining optimal facility location strategies. This interaction is modeled as a simultaneous game and solved by a new algorithm. Viewing minimizing the expected disruption- solution of the proposed game- as one of the objectives, facility location problem is modeled as a multi-objective optimization problem and an evolutionary algorithm is employed to solve it.

■ MA68

Mezzanine - 100I

Teaching and Evaluating Decision-Making Competence

Sponsor: Decision Analysis

Sponsored Session

Chair: Nadine Oeser, PhD Candidate, London School of Economics and Political Science, Rheinstrasse 63, Berlin, 12159, Germany, N.Oeser@lse.ac.uk

1 - Decision Analysis as Part of Educational Reform

Carl Spetzler, CEO, Strategic Decisions Group, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

In this session we will review how training youth in decision analysis fits into "21st Century Education" models. We will see that decision skills are the keystone for integrating the three basic domains of creativity, SEL (Social Emotional Learning), and Critical Thinking into a practical skill. Seen with this perspective, decision skills are central to most of the educational reform movements.

2 - Delivering Decision Analytic Content to Youth

Chris Spetzler, Executive Director, Decision Education Foundation, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, chris@decisioneducation.org

It's Your Choice, a 20 hour course in Decision Skills, delivers Decision Analytic content to youth through short online videos extended with activities to reinforce learning. This session will provide a course overview and cover recent and planned implementation experiences, including opportunities for Decision Professionals to offer the course.

3 - Building Ahoona: The Decision-Making Social Network®
Ali Abbas, Associate Professor and Director, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61822, United States of America, aliabbas@illinois.edu

Wikipedia has shown us that people love to help others with their expertise. The result was the finest encyclopedia that exists today. Facebook has shown us that people love to connect with friends in a social network. The result was one of the largest companies that exist today. This talk will discuss the creation of Ahoona; a decision-making social network that connects people and enables them to offer decision expertise. Learn how you can help and the opportunities available. www.ahoona.com

4 - Individual Decision-Making Competence (IDMC) of Young Adults: A Psychometric Test
Nadine Oeser, PhD Candidate, London School of Economics and Political Science, Rheinstrasse 63, Berlin, 12159, Germany, N.Oeser@lse.ac.uk

Most advanced research defines IDMC mainly in terms of an individual's ability to resist decision biases, a concept that is derived from behavioural decision theory. This approach does not cover decision analytical components such as the ability to envision one's objectives. To provide a broader understanding of IDMC from a DA perspective, this research aims to develop a psychometric test that allows one to measure decision-making performance on various decision analytic components.

■ MA69

Mezzanine - 100J

Decision Analysis III: Strategic Decision Making under Risk

Contributed Session

Chair: Julia Phillips, Argonne National Lab, 9700 S Cass Ave., Bldg. 203, Argonne, IL, 60439, United States of America, phillipsj@anl.gov

1 - Analysis of Nuclear Terrorism Threats with Imperfect Information
Paul Cronin, University of Texas at Austin, CBA 5.334A, 2100 Speedway Stop B6500, Austin, TX, 78712, United States of America, paul.cronin@phd.mccombs.utexas.edu, John Butler, James Dyer, Tom Edmunds

Protection of commercial nuclear fuel cycles against adversaries who desire weapons-usable material is a challenging problem given the numerous potential fuel cycle configurations and security measures that can be deployed. A mixed-integer optimization problem solves a decision tree to allocate security resources across a fuel cycle configuration. We use a sequential game-theoretic formulation (Stackelberg game), and demonstrate the methodology on a nominal UREX+ reprocessing facility.

2 - What Does the Bad Guy Think?
Julia Phillips, Argonne National Lab, 9700 S Cass Ave., Bldg. 203, Argonne, IL, 60439, United States of America, phillipsj@anl.gov, Gilbert Bassett, William Buehring, James Peerenboom, Ronald Whitfield

The ability to account for the values of an adversary has been a challenge in the determination of risk to critical infrastructure. We describe an innovative methodological approach to collect, analyze and incorporate inputs from experts simulating the adversary into the determination of risk to potential targets. We use value-focused thinking to incorporate the preferences of the adversary into the evaluation of threat to the target and present an example applied to an infrastructure problem

3 - Semantic Clinical Decision Support System
Clarence Augustine Tee, CEO/Professor, e-Oncologist, Stanford, 3505 El Camino Real, Palo Alto, CA, 94306, United States of America, catht@e-oncologist.com

Clinical decision support systems are receiving great attention today for improving quality of care. This paper proposes an integrated semantic web supported by key stakeholders to incorporate a comprehensive solution in bringing precision medicine closer to patients. We find that both patients and hospitals can potentially benefit tremendously by employing this novel architecture.

4 - Optimal Selection of Subset of Variables in Linear Regression
Filiz Ersoz, Associate Professor, Karabuk University, Engineering Faculty, Department of Industrial Engineering, Baliklarkayasi Mevkii 78050, Karabuk, Turkey, fersoz@karabuk.edu.tr, Stan Uryasev

This paper compares approaches for selecting subset of explanatory variables in linear regression using adjusted R2 criterion. We conducted a case study for datasets downloaded from the UCI Machine Learning Repository. 10 different datasets with different sample sizes and number of factors are included in the analysis. We compared our calculations with the optimal results presented in Myashiro and Takano. We have run several commercial packages, IBM SPSS Statistics, IBM SPSS Modeler, Minitab and Portfolio Safeguard to benchmark the known optimal subsets of variables.

■ MA70

Mezzanine -101A

Airline Revenue Management in the New World of Customer Choice and Merchandising

Sponsor: Aviation Applications

Sponsored Session

Chair: Emmanuel Carrier, Delta Airlines, 1030 Delta Blvd, Atlanta, GA, 30320, United States of America, Emmanuel.Carrier@delta.com

1 - Estimating Flight-Level Price Elasticities using Online Airline Data
Laurie Garrow, Georgia Institute of Technology, 790 Atlantic Drive, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu, Stacey Mumbower, Matthew Higgins

We estimate flight-level price elasticities using a database of online prices and seat map displays. We use an approach that corrected for price endogeneity; failure to do so resulted in incorrect pricing recommendations. We use an instrumented variable approach (two-stage least squares regression) to address this problem, and find a set of valid instruments that can be used in future studies of air travel demand. We use elasticity results to show how airlines can design better promotions and strategically match a subset of their competitors' sale fares.

2 - Threshold RM with Limited Forecasting
Wei Wang, PROS, Inc., 3100 Main St., Houston, TX, United States of America, Weiwang@pros.com, Tom Gorin

We present a threshold control based RM method having limited forecasting. Starting with user provided initial values, the thresholds are adjusted across both departures and DCPs to approximate user specified month/market load factor goals. Empirical comparisons to FCFS and EMSRb under priceable, hybrid and yieldable demand scenarios are also provided.

3 - Estimating a Model of Airline Passenger Choice using Grouped Data and Least Squares Regression
Emmanuel Carrier, Delta Airlines, 1030 Delta Blvd, Atlanta, GA, 30320, United States of America, Emmanuel.Carrier@delta.com, Larry Weatherford

We estimate a model of airline passenger choice using grouped booking data and least squares regression rather than the standard approach based on individual booking data and maximum likelihood estimation. We adapt the little-known and somewhat forgotten transformation techniques proposed by Berkson (1944) and Theil (1969) while correcting for heteroskedasticity using weighted least squares. We illustrate how to apply the methodology for RM applications for data grouped by path and fare class.

4 - Optimal Fencing in Airline Industry with Demand Leakage
Mihaela Turiac, Qatar University - College of Business & Economics, PO Box 2713, Office B123, Doha, Qatar, michelle.turiac@qu.edu.qa, Syed Asif Raza

This research introduces the fencing mechanism in an integrated framework for fair pricing and seat inventory control decisions of an airline company. An integrated framework of fencing, fair pricing and seat inventory control optimization is proposed to investigate how an airline can retain gains under demand leakage and what would be the effects of fencing investments decisions.

■ MA71

Mezzanine -101B

Air Transportation and the Environment

Sponsor: Aviation Applications

Sponsored Session

Chair: Payuna Uday, Purdue University, 701 W. Stadium Avenue, ARMS 3173, West Lafayette, IN, 47907, United States of America, puday@purdue.edu

1 - Runway Assignments that Minimize Terminal Airspace and Airport Surface Emissions
John-Paul Clarke, Associate Professor, Georgia Tech, 270 Ferst Drive N.W., Atlanta, GA, 30332-0150, United States of America, johnpaul@gatech.edu, Bosung Kim, Leihong Li

Arrivals and departures often experience unnecessary delays and generate unnecessary emissions during peak periods because one or more runways at an airport are in great demand while other runways at the same airport are underutilized. We present an optimization model for simultaneously assigning aircraft to runways, and scheduling the arrival and departure operations on these runways, such that the total emissions produced in the terminal area and on the airport surface is minimized.

2 - Modeling an Airline's use of New Aircraft Concepts under Environmental Constraints

Isaac Tetzloff, Graduate Research Assistant, Purdue University, 701 W. Stadium Ave., West Lafayette, IN, 47907, United States of America, isaact@purdue.edu, William Crossley

To know the environmental impact of new aircraft, we need to represent how a profit-seeking airline will use the new aircraft. Modeling the airline's decision making process through an aircraft allocation and fleet assignment problem help evaluate the best way to represent the airline and strike a balance between the realism of the model and computational effort. This model evaluates the airline's use of new aircraft in response to various environmental constraints, particularly related to CO2.

3 - Flight Trajectory Optimization

Srinivas Bollapragada, Principal Scientist, General Electric, 1 Research Circle, K1-4A50A, Niskayuna, NY, 12309, United States of America, bollapragada@ge.com

We developed and implemented a novel algorithm to control the trajectory of a flight to reduce the costs incurred. Our algorithm computes near-optimal values for the parameters to be entered into an aircraft's flight management system to minimize the fuel and schedule adherence costs incurred on the flight. We implemented our algorithm in a prototype software system that is currently in use at GE Aviation Services.

■ MA72

Mezzanine -101C

Credit, Liquidity, and Systemic Risk

Cluster: Risk Management

Invited Session

Chair: Agostino Capponi, Johns Hopkins University, Whitehead Hall 3400, North Charles Street, Baltimore, United States of America, agcappo@gmail.com

1 - Leveraged Hedge Funds and their Effect on the Systemic Risk

Dimitrios Bisias, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, United States of America, dbisias@mit.edu, Andrew Lo

In this paper we study leveraged hedge funds and the effect of their trading on the stability of the financial system.

2 - Risk Theory for Large Insurance Portfolios

Jose Blanchet, Professor, Columbia University, 500W 120th Street, New York, NY, United States of America, jose.blanchet@columbia.edu, Xinyun Chen, Henry Lam

Traditional ruin models are constructed from a top-down approach. Motivated by models with large numbers of customers, specially in life insurance mathematics (including, for example, pension fund dynamics), we revisit some classical insurance models from a bottom-up perspective. We demonstrate how these important applications provide a natural framework for modern Operations Research techniques such as the diffusion approximations and large deviation analysis of many server systems.

3 - Fluctuation Analysis for the Loss from Default

Justin Sirignano, Stanford Univerisity, Huang Engineering Center, Stanford, United States of America, jasirign@stanford.edu, Konstantinos Spiliopoulos, Kay Giesecke

The loss from default in large credit portfolios is typically computationally expensive to evaluate. We analyze the fluctuation of the loss from default around its large portfolio limit in a class of reduced-form models of correlated firm-by-firm default timing. We prove a weak convergence result for the fluctuation process and use it for developing a conditionally Gaussian approximation to the loss distribution.

4 - Optimal Systemic Risk Mitigation in Financial Networks

Agostino Capponi, Johns Hopkins University, Baltimore, MD, United States of America, acappon1@jhu.edu, Peng Chu-Chen

We propose a multi-period bilateral clearing framework, where systemic risk is mitigated through an optimal bailout strategy. Interbank liabilities evolve stochastically over time, and default events have a persistent impact on the the network. The optimal bailout policy and clearing payments are recovered as solution of a stochastic dynamic programming problem. Our analysis provides a tool to support regulator decisions of when and where to intervene to prevent financial stability.

Monday, 11:00am - 12:30pm

■ MB01

Level 2 - Room 200A

Optimization, Spatial Analysis and GIS 2

Cluster: Optimization, Spatial Analysis and GIS

Invited Session

Chair: Richard Church, Professor, University of California, Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106-4060, United States of America, church@geog.ucsb.edu

1 - Predictive Environmental Analysis System

Jayant Kalagnanam, IBM T.J. Watson Research Center, 1101 Kitchawan Rd., PO Box 218, Yorktown Heights, NY, 10598, United States of America, jayant@us.ibm.com, Stuart Siegel, Sayan Ranu, Jun Zhang, Lun Zhong

We highlight the use of spatio temporal data for building predictive models for air quality, dengue, and weather. The sources of data are multi modal such as radar, air quality and weather monitoring stations. The aggregation this information semantically to build statistical and decision models is discussed.

2 - A GIS Scheduling System for Fuels Treatment Optimization in National Forests; A Look under the Hood

Matthew Niblett, University of California, Santa Barbara, 1832 Ellison Hall, UC Santa Barbara, Santa Barbara, CA, 93106-4060, United States of America, mniblett@geog.ucsb.edu, Richard Church

The United States Forest Service (USFS) uses fuels treatments to reduce the number and extent of high intensity forest fires in the western United States. We present the details of integrating a fuels treatment scheduling model (FIRS) with a GIS database and visualization system. We describe specific issues that needed to be addressed in merging a large scale integer programming problem with GIS software.

3 - The Continuous K-medians Problem in a Convex Polygon

Raghuveer Devulapalli, University of Minnesota, 111 Church St., SE, Office L100, Minneapolis, MN, 55455, United States of America, devul002@umn.edu, John Carlsson

Given an convex polygon C and an integer k, we present a fast and simple factor 2.02 approximation algorithm for the continuous k-medians problem. The objective here is to chose k landmark points so as to minimize the average distance between these landmark points and set of clients who are located uniformly within the convex polygon. The key to our algorithm is a geometric relationship between any convex polygon and its minimum bounding box.

4 - Euclidean Hub-and-Spoke Networks

Fan Jia, University of Minnesota, 111 Church St., SE, Minneapolis, MN, 55108, United States of America, jiaxx049@ie.umn.edu, John Carlsson

We consider the problem of designing an optimal hub-and-spoke network in continuous euclidean space and our objective is to determine the optimal number and locations of hub nodes. We consider five different backbone network topologies (TSP, MST, Steiner tree, star network, complete graph) for connecting the hub nodes and describe the asymptotically optimal configurations that minimize the total network costs. We give an approximation algorithm that solves our problem on a convex planar region.

■ MB02

Level 2 - Room 200B

Scheduling and Logistics

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: R. Logen Logendran, Professor, Oregon State University, School of Mech, Indust, and Mfgr Engr, 204 Rogers Hall, Corvallis, OR, 97331-6001, United States of America, logendrr@engr.orst.edu

1 - Developing a Tight Lower Bound for a Group Scheduling Problem in Hybrid Flow Shops

Mir Abbas Bozorgirad, PhD Candidate, Oregon State University, School of Mech, Indust, and Mfgr Engr, 204 Rogers Hall, Corvallis, OR, 97331-6001, United States of America, bozorgim@onid.orst.edu, R. Logen Logendran

We develop a tight lower bound for a group scheduling problem in hybrid flow shops where the parallel machines are unrelated. The objective of the problem is to minimize a linear combination of total weighted completion time and total weighted tardiness of jobs. The underlying assumptions include the sequence-dependent setup times and dynamic job release times. The lower bound is developed using a column generation technique and further improved with the help of a branch-and-price algorithm.

2 - A Branch-and-Price Algorithm for a Dynamic PCB Assembly System

Mohammad Yazdani Sabouni, PhD Candidate, Oregon State University, School of Mech, Indust, and Mfgr Engr, 204 Rogers Hall, Corvallis, OR, United States of America, yazdanim@onid.orst.edu, R. Logen Logendran

A dynamic printed circuit board (PCB) assembly system is introduced in which the internal (machine) and external (kitting) setup times are integrated. The problem is NP-hard implying the need for lower bounds. A lower bound based on the idea of the branch-and-price (B&P) algorithm is developed. A branching strategy superior to the conventional branching in B&P is proposed. Nevertheless, the sub problems are NP-hard and several properties on the contribution of the sub problems are proposed.

3 - Operating Rooms Capacity Allocation for Emergency Patients

Yiwei Huang, Texas A&M University, Mays Business School, 320R Wehner, 4217 TAMU, College Station, TX, United States of America, yhuang@mays.tamu.edu, Natarajan Gautam, Xitong Guo, Chelliah Sriskandarajah

Hospitals face a trade-off between the need to be responsive to emergency cases and to conduct scheduled elective surgeries efficiently. To increase the efficiency, we develop an approximation model which allocates the operating room capacity for different priority classes of emergency patients. The objective is to develop a capacity-allocation model that can achieve a better performance. This helps hospitals efficiently utilize the rest of operating room capacity to schedule elective surgeries.

■ MB03

Level 2 - Room 200C

Combinatorial Methods in Global Optimization

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Marcia Fampa, Universidade Federal do Rio de Janeiro, PESC/COPPE, CP 68511, Rio de Janeiro, RJ, 21941-972, Brazil, fampa@cos.ufrj.br

1 - Augmentation Algorithms for Linear and Integer Linear Programming

Jon Lee, University of Michigan, 1205 Beal Ave., Ann Arbor, United States of America, jonxlee@umich.edu, Jesus De Loera, Raymond Hemmecke

Taking motivation from Bland's LP generalization of the theoretically-efficient Edmonds-Karp max-flow algorithm, we generalize his augmentation scheme to integer programming, with some surprising consequences.

2 - Molecular Structure Determination by a Discrete Geometric Approach

Carlile Lavor, Dr., UNICAMP, IMECC - UNICAMP, Campinas, SP, 13083-859, Brazil, clavor@ime.unicamp.br

The problem of identifying 3D molecular structures by exploiting distance information is a Molecular Distance Geometry Problem (MDGP), which can be formulated as a nonconvex global minimization problem. Defining an artificial ordering on the atoms of the protein molecule, we can prove that the MDGP can be reformulated as a combinatorial problem and solved by an exact algorithm: the Branch and Prune (BP) algorithm.

3 - MINLP Formulations for the Euclidean Steiner Problem

Nelson Maculan, Universidade Federal do Rio de Janeiro, PESC/COPPE, CP 68511, Rio de Janeiro, RJ, 21941-972, Brazil, nelson.maculan@gmail.com, Marcia Fampa, Brìgida Sartini

We present two Mixed Integer Non-Linear Programming (MINLP) formulations for the Euclidean Steiner problem and analyze the performance of MINLP solvers on the solution of test instance.

■ MB04

Level 2 - Room 200D

Integer Programming and Cutting Planes

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Muhong Zhang, Assistant Professor, Arizona State University, 699 S Mill Ave., Tempe, AZ, 85281, United States of America, Muhong.Zhang@asu.edu

1 - Cutting-plane Algorithms for a Robust Sensor Cover and Communication Problem

J. Cole Smith, Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, cole@ise.ufl.edu, Andrew Romich, Guanghui Lan

We consider sensor placement to cover a set of targets in a region, in a manner that allows sensors to communicate with one another. Communication effectiveness for each sensor pair is determined by a concave function of distance between the sensors. Also, final sensor placement is stochastic, as caused by drifting. We maximize a communication effectiveness metric, and require all targets to be covered by some sensor, where sensor drift occurs according to a robust (worst-case) mechanism.

2 - Multicommodity Variable Upper Bound Flow Models

Deon Burchett, PhD Student, University of Florida, 406-A Weil Hall, Gainesville, FL, 32611, United States of America, deonlb@ufl.edu, Jean-Philippe Richard

Variable upper bound flow models are well-studied in the MIP literature. Their study has yielded inequalities that are useful in computation. We consider a multicommodity extension of variable upper bound flow models. We perform a polyhedral study of this extended model, investigating novel aspects of its structure while also examining its relationship to the single-commodity case. In particular, we identify a large family of inequalities that generalizes well-known flow cover inequalities.

3 - Valid Inequalities for Bilevel Integer Program

Muhong Zhang, Assistant Professor, Arizona State University, 699 S Mill Ave., Tempe, AZ, 85281, United States of America, Muhong.Zhang@asu.edu

Bilevel integer programs optimize hierarchical objective functions with integer variables. In this talk, we analyze the valid inequalities for the feasible upper level optimal solutions and discuss corresponding branch and bound algorithms. Numerical experiments will be presented to demonstrate the computational efficiency.

■ MB05

Level 2 - Room 200E

Interdiction Models in Complex Networks

Sponsor: Optimization/Networks

Sponsored Session

Chair: Alexander Veremyev, NRC Research Associate, Munitions Directorate, Air Force Research Laboratory, 101 West Eglin Blvd, Eglin AFB, United States of America, averemyev@gmail.com

1 - Minimum Vertex Cover Problem for Coupled Interdependent Networks with Cascading Failures

Alexander Veremyev, NRC Research Associate, Munitions Directorate, Air Force Research Laboratory, 101 West Eglin Blvd, Eglin AFB, United States of America, averemyev@gmail.com

We study a generalization of the classical minimum vertex cover problem to the case of interdependent networks, i.e., identifying a minimum-cardinality set of nodes, whose deletion would eectively disable both network layers through cascading failure mechanisms. We analyze the computational complexity, develop linear 0-1 formulations and discuss other related issues. Computational experiments are reported to illustrate the performance of the developed models.

2 - Critical Node Detection in Coupled Interdependent Networks with Uncertain Failure Propagations

Konstantin Pavlikov, University of Florida, 303 Weil Hall, PO Box 116595, Gainesville, FL, 32611-6595, United States of America, kpavlikov@ufl.edu, Alexander Veremyev, Vladimir Boginski, Stan Uryasev

We consider the problem of identifying critical nodes in interdependent networks whose deletion causes the maximum damage to the network with uncertain failure propagations. To quantify the "damage"we use Conditional Value-at-Risk (CVaR) of two commonly used disruption metrics: total number of disabled nodes and total number of disabled pair-wise connectivities. Scenario-based linear IP model and exact algorithm are developed and compared for small-sized network instances.

3 - Maximum Weighted Clique Network Interdiction via Vertex Deletions

Foad Mahdavi Pajouh, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States of America, mahdavi@ufl.edu, Eduardo Pasiliao, Vladimir Boginski

Cliques are among the earliest concepts used to model cohesive clusters in graphs. A clique is a subset of vertices that induces a complete subgraph. Given an integer r>0, we consider the problem of removing a subset of vertices of minimum cardinality in a weighted undirected graph, such that the weight of any remaining clique is bounded above by r. A linear 0-1 programming formulation, an exact algorithm for solving this problem, and its complexity on unweighted graphs will be presented.

4 - On a Linear Assignment Interdiction Problem

Vladimir Stozhkov, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, vstozhkov@ufl.edu, Vladimir Boginski

We consider a bilevel extension of the linear assignment problem. The follower solves an assignment problem maximizing his profit, while the leader may interdict removing some of the nodes of the graph. The leader's task is to minimize the total cost given by the cost of interdiction plus the cost of the assignments made by the follower. The problem is shown to be NP-hard. We also derive equivalent linear mixed 0-1 programming reformulations and discuss possible heuristic solution approaches.

■ MB06

Level 2 - Room 200F

Linear Programming Approaches to Dynamic Programming

Sponsor: Optimization/Linear Programming and Complementarity

Sponsored Session

Chair: Ilbin Lee, PhD Student, University of Michigan, 1205 Beal Ave., Ann Arbor, Mi, 48109, United States of America, ilbinlee@umich.edu

1 - Convergence Rate Analysis of the Simplex Algorithm for Non-stationary Markov Decision Processes

Ilbin Lee, PhD Student, University of Michigan, 1205 Beal Ave., Ann Arbor, Mi, 48109, United States of America, ilbinlee@umich.edu, Marina Epelman, Edwin Romeijn, Robert Smith

A nonstationary Markov decision process (MDP) is an infinite-horizon MDP with time-varying problem data. It can be formulated as countably infinite linear program (CILP), and recently, a simplex algorithm for the CILP was suggested. Given a desired accuracy epsilon, we show that the number of pivots of the simplex algorithm with a particular pivoting rule to achieve this accuracy is O(N^3S^2A log(N+log S)(log S)^4) where N=log(epsilon) and S and A are the number of states and actions, resp.

2 - Strong Polynomiality of Policy Iterations for Average-cost MDPs Modeling Replacement and Maintenance

Eugene Feinberg, Stony Brook University, Department of Applied Mathematics, Stony Brook, NY, United States of America, eugene.feinberg@stonybrook.edu, Jefferson Huang

This talk considers an average-cost Markov Decision Process (MDP) with finite state and action sets and satisfying the additional condition that there is a state to which the system jumps from any state and under any action with a positive probability. The main result is that the policy iteration algorithm is strongly polynomial for such MDPs, which are often used to model replacement and maintenance problems.

3 - Strategy Iteration is Strongly Polynomial for Turn-Based Stochastic Games with a Fixed Discount Rate

Thomas Dueholm Hansen, Postdoc, Tel Aviv University, PO 39040, Tel Aviv 69978, Tel Aviv, Israel, tdh@cs.au.dk, Peter Bro Miltersen, Uri Zwick

Ye showed recently that the simplex method with Dantzig's pivoting rule, as well as Howard's policy iteration algorithm, solve discounted Markov decision processes, with a constant discount factor, in strongly polynomial time. We improve Ye's analysis in two respects. First, we show a tighter bound for Howard's policy iteration algorithm. Second, we show that the same bound applies to the strategy iteration algorithm used for solving 2-player turn-based stochastic games with discounted rewards.

4 - The Simplex Method is Strongly Polynomial for Deterministic Markov Decision Processes

Yinyu Ye, Professor, Stanford University, Huang 308, Stanford, CA, 94305, United States of America, yinyu-ye@stanford.edu, Ian Post

We prove that the simplex method with the highest gain/most-negative-reduced cost pivoting rule converges in strongly polynomial time for deterministic Markov decision processes (MDPs) regardless of the discount factor. Previously the simplex method was known to run in polynomial time only for discounted MDPs where the discount was fixed and bounded away from 1.

■ MB07

Level 2 - Room 200G

Robust Design

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Chaithanya Bandi, Massachusetts Institute of Technology, 20 Palermo St., 16C2, Cambridge, MA, 02141, United States of America, c-bandi@kellogg.northwestern.edu

1 - Prior-Independent Mechanisms for Scheduling

Balasubramanian Sivan, PhD Student, University of Wisconsin-Madison, 1210 W Dayton St., Computer Sciences, 53706, Madison, WI, 53706, United States of America, balu2901@gmail.com, Shuchi Chawla, Jason D. Hartline, David L. Malec

Consider the problem of scheduling on jobs on unrelated selfish machines to minimize the completion time of the last job, i.e., makespan minimization with unrelated selfish machines. We assume that job sizes are stochastic. We design simple truthful mechanisms that under various distributional assumptions provide constant and sublogarithmic approximations to expected makespan. Our mechanisms are prior-independent in that they do not rely on knowledge of the job size distributions.

2 - Robust Mechanism Design

Chaithanya Bandi, Massachusetts Institute of Technology, Cambridge, MA, United States of America, cbandi@mit.edu

In this paper, we revisit the auction design problem for multi-item auctions with budget constrained buyers by introducing a robust optimization approach to model (a) concepts such as incentive compatibility and individual rationality that are naturally expressed in the language of robust optimization and (b) the auctioneer's beliefs on the buyers' valuations of the items.

3 - Robust Experimental Design: Optimal Assignment for Powerful Inference

Nathan Kallus, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu, Dimitris Bertsimas, Mac Johnson

Random assignment, typically seen as the standard in controlled trials, aims to make experimental groups statistically equivalent before treatment. However, with a small sample, which is a practical reality in many disciplines, randomized groups are often too dissimilar to be useful. We propose an optimal assignment mechanism based on regression robustness that offers theoretically-motivated, powerful statistical inference and estimation.

■ MB08

Level 2 - Room 200H

Computational Linear and Integer Programming II

Sponsor: Computing Society

Sponsored Session

Chair: Jason Sauppe, PhD Student, University of Illinois at Urbana-Champaign, 201 North Goodwin Avenue, Urbana, IL, 61801, United States of America, sauppe1@illinois.edu

1 - Generating Minimal Valid Inequalities

Emre Yamangil, Research Assistant, Rutgers University Center for Operations Research, 640 Bartholomew Road, Piscataway, NJ, 08854, United States of America, emreyamangil@gmail.com, Endre Boros

We consider the problem of generating a lattice-free convex set to construct a valid inequality that minimizes the sum of its coefficients for 2-row simplex cuts. We show that a pseudo-polytime generation of a "best" lattice-free convex set is possible. Applying these cuts lead to a non-negligible reduction in the size of the branch-and-cut tree.

2 - Finding Diverse Solutions of High Quality to Binary Integer Programs

Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01609, United States of America, atrapp@wpi.edu, Renata Konrad

While the standard output of an optimization solver is a single optimal solution, at times a set of high-quality and diverse solutions might be very beneficial. We discuss a new, general method to obtain such solutions to pure binary integer programs. We use fractional programming techniques and Dinkelbach's algorithm to generate solutions that evaluate well with respect to both 1) individual performance and, as a whole, 2) mutual variety. We conclude with encouraging computational results.

3 - Solving the Pricing Problem in Branch-and-Price using Zero-Suppressed Binary Decision Diagrams

David Morrison, University of Illinois, Urbana-Champaign, 201 N Goodwin Ave., Urbana, IL, United States of America, morris50@illinois.edu, Edward Sewell, Sheldon Jacobson

Zero-suppressed binary decision diagrams (ZDDs) are data structures that compactly encode families of sets; in this talk, it is shown how to use ZDDs to characterize valid solutions to the pricing problem in a branch-and-price setting. A linear-time algorithm is given to add restrictions to the ZDD so that standard branching rules can be employed without destroying pricing problem structure. Computational results for the graph coloring problem are given to show the method's effectiveness.

4 - Efficient Staff Rostering using Column Generation and Generic Programming

Andrew Mason, Senior Lecturer, University of Auckland, Private Bag 92019, Auckland, New Zealand, a.mason@auckland.ac.nz, Anders Dohn

We present a new software system for solving staff rostering problems using column generation. Customising the system for each problem requires specifying problem-specific states and rules to use in the column generator. To do this efficiently, we exploit generic programming principles in which these problem-specific details are given at compile time. This gives a significant improvement in flexibility and a dramatic reduction in run-times.

■ MB09

Level 2 - Room 200I

Innovative Applications in Analytics Award II

Sponsor: Analytics Section

Sponsored Session

Chair: Pooja Dewan, General Director, Burlington Northern Santa Fe Corporation, 2400 Western Center, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

1 - Innovative Applications in Analytics Award

Pooja Dewan, General Director, Burlington Northern Santa Fe Corporation, 2400 Western Center, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

The purpose of the third annual Innovative Applications in Analytics Award is to recognize creative and unique developments, applications or combinations of analytical techniques used in practice. The prize promotes the awareness of the value of analytics techniques in unusual applications, or in creative combination to provide unique insights and/or business value. These three sessions in the INFORMS annual meeting will be focused on having the 9 Semi-finalists of the award present their work to a panel of judges. At the end of the sessions, the judges will deliberate and determine the 3 Finalists that will present in the Spring INFORMS of 2014.

2 - An Innovative Tool to Monitor, Predict and Optimize Effectiveness of Advertising Campaigns

Marc Fischer, University of Cologne, Germany, Thomas Wachter, Christian Rumler

Two factors drive the effectiveness of an advertising campaign: (1) the budget level and its allocation across media and (2) the quality of the campaign and its execution. Analytical approaches that enable management to monitor, predict, and optimize campaigns are rarely available. We offer an innovative approach that is based on survey data. The tool uses analytical techniques that are descriptive, predictive, and prescriptive. It has been implemented at Mercedes-Benz and was applied to four recent major ad campaigns. Mercedes-Benz significantly improved its campaign management over time and identified a savings potential of up to EUR 2 million by campaign.

3 - Quality and Service Analytics Tool Box

Ramachandran Chandrashekhar, HP Global Analytics, Pavithra V., Ramani Sathyanarayana, Sharmila Samuel, Gayathri Arunkumar, K.V. Nathan

The 'Quality & Services analytics toolbox' with its 360 degree view of data and advanced analytics capabilities has helped to identify & statistically predict the drivers of product and service quality, which in turn have helped to cut costs and improve profitability in HP's PC business in Asia.

4 - Enabling Greater Sustainability in Vehicle Fleet Sales through Customer Oriented Analytics

Daniel Reich, Ford Motor Company, 2101 Village Rd., Dearborn, MI, United States of America, dreich8@ford.com, Natalie Olson, Erica Klampfl, Sandra L. Winkler

Ford's Fleet Purchase Planner (patent pending) is the first of its kind in promoting sustainability as a central purchase consideration for organizations with large vehicle fleets. In recent years, several new green vehicle technologies have emerged that present opportunities for increasing fuel economy, but this growing number of options is also making planning purchases a significantly more complicated endeavor. This decision support system is designed to simplify this process by optimizing for individual driving patterns. We are helping our fleet customers find the most cost-effective opportunities for increasing their sustainability.

■ MB10

Level 2 - Room 200J

Joint Session CPMS/TSL/JFIG: A Panel Discussion on Academic-Industry Collaboration

Sponsor: CPMS, The Practice Section, Transportation Science & Logistics, & Junior Faculty Interest Group

Sponsored Session

Chair: Karen Smilowitz, Associate Professor, Northwestern University, Technological Institute M233, 2145 Sheridan Road, Evanston, IL, 60208-3119, United States of America, ksmilowitz@northwestern.edu

1 - A Panel Discussion on Academic-industry Collaboration

Moderator: Karen Smilowitz, Associate Professor, Northwestern University, Technological Institute M233, 2145 Sheridan Road, Evanston, IL, 60208-3119, United States of America, ksmilowitz@northwestern.edu, Panelists: Lawrence V. Snyder, Sean Willems, Judith Guzzetta, Alan Erera

Please join us for a lively, open discussion of industry/academia research collaboration. Panelists from a mix of industry and academia will discuss collaboration strategies, focusing on best practices and pitfalls to avoid. Ph.D. students and junior faculty are encouraged to attend; panelists will discuss how to successfully initiate and implement collaborations, and how to turn collaborations into strong publications.

■ MB11

Level 2 - Room 201A

In Honor of Saul Gass I

Cluster: In Memoriam: Saul Gass's Influence in OR

Invited Session

Chair: Edward Wasil, American University, Kogod School of Business, Washington, DC, 20016, United States of America, ewasil@american.edu

Co-Chair: Bruce Golden, Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, bgolden@rhsmith.umd.edu

1 - Looking Backwards, Looking Forwards: Reflections on Definitions of OR by Morse and Kimball

Richard Larson, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, rclarson@mit.edu

Saul Gass was a consummate modeler and an exemplary member of the OR community. He was "in at the beginnings" of OR and provided stalwart mentorship to those younger than him throughout his career. He was an old-time OR guy. In appreciation of that, we honor Saul by going back to the beginnings and examine OR as Morse and Kimball defined it in the 1950's and then project forward. In honor of Saul, we hope to be able to elucidate a few extreme points.

2 - The Allocation of Indivisible Objects via Rounding

Rakesh Vohra, Kellogg School of Management, Northwestern University, Evanston, IL, 60201, United States of America, r-vohra@kellogg.northwestern.edu, Thanh Nguyen

Allocating indivisible objects arises in spectrum licenses, landing slots at airports and assigning students to schools. This paper proposes a technique for making allocations based on rounding a fractional allocation. Under the assumption that no agent wants to consume more than k items, the technique can be interpreted as giving agents lotteries over approximately feasible integral allocations that preserve the ex-ante efficiency and fairness properties of the initial fractional allocation.

3 - Using Magnetic Resonance Imaging Data to Predict and Locate Prostate Cancer

David Anderson, Robert H.Smith School of Business, University of Maryland, College Park, MD, 20742, United States of America, davidryberganderson@gmail.com, Bruce Golden, Edward Wasil, Hao Zhang

We propose a method of diagnosing prostate cancer using magnetic resonance imaging data. Logistic regression and nearest neighbor classification are combined to identify the risk of cancer. Our method performs well with 79% predictive accuracy and an area under the ROC curve of 0.85.

■ MB12

Level 2 - Room 201B

SpORts - Analysis of Data and Strategies II

Sponsor: SpORts

Sponsored Session

Chair: James Cochran, Louisiana Tech University, Ruston, LA, United States of America, jcochran@latech.edu

1 - Who's Good this Year? Comparing the Information Content of Games in the Four Major US Sports

Julian Wolfson, Assistant Professor, University of Minnesota Division of Biostatistics, A460 Mayo Memorial Building MMC 303, 420 Delaware St., SE, Minneapolis, MN, 55455, United States of America, julianw@umn.edu, Joe Koopmeiners

The number of regular season games played in the four major US professional sports leagues ranges from 16 to 162, suggesting that the outcome of an NFL game gives more insight about the relative strength of the teams involved than an MLB game. We quantify the amount of information each game yields about relative team strength, and find dramatic differences between sports in the ability of past game outcomes to predict future results.

2 - On the Benefit of the Sacrifice Bunt: Getting Your Objectives Straight

J. Eric Bickel, University of Texas, 1 University Station, C2200, ETC 5.128D, Austin, TX, 78712-0292, United States of America, ebickel@mail.utexas.edu, Nobuyoshi Hirotsu

In this talk we analyze the benefit of the sacrifice bunt in Major League Baseball games under two different objectives: maximizing the expected number runs scored or maximizing the probability of winning. We demonstrate that focusing on the true objective (i.e., winning) leads to attempting the sacrifice in more situations than maximizing the expected number of runs.

3 - Olympic Track and Field and Swimming: Politics and Drugs, Gender Differentials, Home Nation Advantage

Raymond Stefani, Professor Emeritus, California State University, Lon Beach, 25032 Via Del Rio, Lake Forest, CA, 92630, United States of America, Raymond.Stefani@csulb.edu

Improvement trends for Olympic winning performances in track & field and swimming reveal the affect of world wars, the cold war, boycotts and the post-1988 crackdown on performance-enhancing drugs. The greatest technological efficiency improvements are discussed. Percent differences in female/male winning performances are shown to be explainable by physiological differences using physics and kinesiology. Home nation medal advantage is evaluated. A residual medal advantage remains after hosting.

■ MB13

Level 2 - Room 202A

Environmentally Sustainable Product Design

Cluster: New Product Development

Invited Session

Chair: Vishal Agrawal, Assistant Professor, Georgetown University, 37th & O Streets, 200 Hariri Building, Washington, DC, 20057, United States of America, va64@georgetown.edu

1 - Design for Recovery or Obsolescence: The Effect of Take-back Legislation

Ximin Huang, Scheller College of Business, Georgia Institute of Technology, 800 West Peachtree Street, NW, Atlanta, GA, 30308, United States of America, ximin.huang@scheller.gatech.edu, Atalay Atasu, Beril Toktay

We consider a monopolist who has two product design options to manage the end-of-life costs/revenues associated with its products: making products more durable or recyclable. We explore how the recyclability and durability choices are affected by the requirements of take-back legislation.

2 - Improving Supplier Environmental Performance

Tim Kraft, Assistant Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, kraftt@darden.virginia.edu, Ozgen Karaer, John Khawam

We examine how a firm can induce higher environmental quality from a supplier under varying cost and market sensitivity conditions. We consider three methods: supplier competition, cost sharing, and revenue sharing. Our research is based on our work with an NGO as it markets to industries a tool to safely share chemical information.

3 - Compliance with Environmental Regulation in Project-based Industries

Gokce Esenduran, Fisher College of Business, Ohio State University, Columbus, United States of America, esenduran_1@fisher.osu.edu, Nicholas G. Hall, Zhixin Liu

We investigate the implications of environmental regulations on project scheduling. We model the decisions of a regulator and multiple project managers (PMs) as a Stackelberg game. The regulator specifies pollution remediation requirements, and the PMs respond either by remediation or by investment in greenness. We describe a subsidy for investment in greenness that coordinates the decisions of the players, and a bonus that ensures truth telling by PMs about their remediation costs.

4 - Economic and Environmental Assessment of Remanufacturing in Competitive Settings

Gal Raz, Associate Professor, University of Virginia, Darden Business School, 100 Darden Blvd., Charlottesville, VA, 22903, United States of America, Razg@darden.virginia.edu, Anton Ovchinnikov, Vered Blass

This paper provides a data-driven assessment of economic and environmental aspects of remanufacturing under competition. We study a product line competition between two firms: one selling new low- and high-end products and the other selling new and refurbished high-end products. We present an analytical model and a behavioral study which together incorporate demand cannibalization from multiple customer segments and examine the impact of remanufacturing on the firms' competition.

■ MB14

Level 2 - Room 202B

Unauthorized Channels and Counterfeit Products

Cluster: Managing Disruptions in Supply Chain

Invited Session

Chair: Foad Iravani, Assistant Professor, Foster School of Business, University of Washington, Seattle, WA, 98004, United States of America, firavani@uw.edu

1 - Gray Markets, Strategic Consumers and Supply Chain Coordination

Hamed Mamani, University of Washington, Box 353226, Foster School of Business, UW, Seattle, WA, 98195-3226, United States of America, hmamani@uw.edu, Foad Iravani, Reza Ahmadi

In this paper we consider the effect of contracts for a supply chain under the threat of gray market activities. If internal gray markets are ignored we show the sub-optimality of a number of otherwise coordinating contracts when consumers are strategic. We propose a contract to coordinate this supply chain.

2 - Towards a Counterfeit-proof Global Supply Chain

Morteza Pourakbar, Rotterdam School of Management, Erasmus University, Burgmaster Oudlaan 50, Rotterdam, 3031AA, Netherlands, mpourakbar@rsm.nl, Rob Zuidwijk

Counterfeiting has become one of the major risks in supply chains. In this paper, we investigate the role of Customs in the fight against counterfeiting. We develop game-theoretic models to study how Customs and supply chain stakeholders can collaborate in order to mitigate the risk of counterfeit products entering the legitimate supply chains.

3 - On the Performance Of Supply Chain Contracts with Domestic Gray Market Externalities

Mehmet Sekip Altug, Assistant Professor, George Washington University, 2201 G. Street NW, Washington, DC, 20052, United States of America, maltug@gwu.edu, Garrett van Ryzin

We consider a supply chain with one manufacturer and several authorized distributors that face uncertain demand and the potential of a domestic gray market emergence, which is possibly fed by local authorized distributors as a result of the incentives manufacturer provides. We characterize the emerging equilibrium in such domestic gray markets. We find out that wholesale pricing is quite robust to the presence of domestic gray markets so much so that manufacturers can even be better off.

4 - Coping with Gray Market: The Impact of Market Conditions and Product Characteristics

Foad Iravani, Assistant Professor, Foster School of Business, University of Washington, Seattle, WA, 98004, United States of America, firavani@uw.edu, Reza Ahmadi, Hamed Mamani

We study the impact of gray markets on a price-setting manufacturer with uncertain demand. Furthermore, we explore the impact of market conditions and product characteristics on the manufacturer's policy towards parallel importation. We also provide managerial insights about the value of strategic decision-making by comparing the optimal policy to the uniform pricing policy that has been adopted by some companies to eliminate gray markets entirely.

■ MB15

Level 2 - Room 203

Workforce Management II

Sponsor: Service Science

Sponsored Session

Chair: Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, mss@us.ibm.com

1 - Sales Team Effort Allocation Analytics

Ban Kawas, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, bkawas@us.ibm.com, Dharmashankar Subramanian, Mark Squillante, Kush Varshney

One of the major sources of expense of a company is its salesforce. In this work, we ask the question of how incremental dollars of sales expense should be invested to maximize revenue. In particular, we develop a predictive analytics solution for allocating effort to sales opportunities based on client attributes, seller attributes, and business constraints.

2 - Stochastic Optimal Control of Dynamic Resource Allocation Problems

Xuefeng Gao, Georgia Institute of Technology, H. Milton School of ISyE, Atlanta, GA, 30332, United States of America, gxf1240@gatech.edu, Yingdong Lu, Mayank Sharma, Mark Squillante, Joost Bosman

We consider a class of dynamic resource allocation problems that intrinsically involves different resource types. The goal is to determine the resource allocation capacities for serving uncertain demand that maximize the expected net-benefit based on rewards and costs associated with the different resources. We derive the optimal control policy within a singular control setting, which includes simple expressions for governing the dynamic adjustments to resource allocation capacities over time.

3 - Sales Territory Optimization

Yingdong Lu, IBM T.J. Watson Research Center, 1101 Kitchawan Rd., Yorktown Heights, NY, United States of America, yingdong@us.ibm.com, Mark Squillante

We determine the optimal allocation of clients to sales resources (territories) according to a set of criteria under uncertainty based on an approach that maps the original stochastic nonlinear MIP to a corresponding multiple, multi-dimensional stochastic knapsacks problem. Fundamental properties of a combination of strategies are established for sequentially allocating a set of items among a collection of knapsacks with respect to maximizing a functional of the overall value of the allocation.

4 - Parallel Server Queueing Systems with Server Arrivals and Departures

Mayank Sharma, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, United States of America, mxsharma@us.ibm.com, Yingdong Lu, Mark Squillante, Bo Zhang

We consider a parallel server queueing system where customers arrive according to a stochastic process, new servers arrive according to another stochastic process, and existing servers depart according to yet another stochastic process.

■ MB16

Level 2 - Room 204

Decision Making in Health Care: Modeling, Analysis, and Applications

Sponsor: Health Applications

Sponsored Session

Chair: Shinyi Wu, Assistant Professor, University of Southern California, 3650 McClintock Ave., OHE 310R, Los Angeles, CA, 90089, United States of America, shinyiwu@usc.edu

1 - Social Psychology Experimental Small Group Studies for Management Decisions with Optimal Choice

Franklin Dexter, Professor, University of Iowa, Department of Anesthesia, 6JCP, 200 Hawkins Drive, Iowa City, IA, 52242, United States of America, franklin-dexter@uiowa.edu, Andrew Prahl, Michel Braun, Lyn Van Swol

Operating room operations research decisions with an optimal choice have ubiquitous biases. We reviewed systematically experimental social-psychology studies to explore what a leader can do when working with stakeholders lacking interest in learning management science but expressing opinions about decisions, nonetheless. Leaders will find the most success if they do not bring operational decisions to groups but instead act autocratically while obtaining needed information in 1:1 conversations.

2 - Decreasing Future Donor Liver Discard via Procurement Strategies for Donation after Cardiac Death

Maria Mayorga, Clemson University, Raleigh, NC, United States of America, mayorga@clemson.edu, Hector Toro-Diaz, Eric Orman, Stephanie Wheeler, A. Sidney Barritt

Using the United Network for Organ Sharing (UNOS) database, predictions show that organ utilization will continue to decline due to donor liver quality. This is due not only to forecasted trends in the donor population (obesity, older donor age) but also in part to the acceptance of organs from donation after cardiac death which are associated with a high rate of discard. Different procurement strategies are evaluated using simulation to predict the effect on liver transplants through 2030.

3 - Fully Adaptive Designs for Clinical Trials: Simultaneous Learning from Multiple Patients

Vishal Ahuja, University of Chicago, United States of America, vahuja@chicagobooth.edu, John Birge

Traditional clinical trials are randomized and the goal is to maximize learning. Adaptive designs, however, use information accrued during the trial. An ideal adaptive design maximizes patient health outcomes without sacrificing any potential learning. We propose such a design, one that fully exploits learning from multiple patients simultaneously. We demonstrate our design's effectiveness on a recent trial. Our design is general and applicable to any MDP setting where learning takes place.

4 - Mathematical Modeling of Pediatric Patients

Jason Card, Graduate Student, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, jasonsc@umich.edu, Amy Cohn, Joe East, Emily Burns, Allison Cator, Michelle Macy, Natalie Eisert

We use mathematical models and data analysis to observe how pediatric patients are treated and discharged. Asthma patients are a specific set of patients studied. We study length-of-stay and other metrics for patients using different discharge methods. We compare the results and discuss the implications of the findings.

■ MB17

Level 2 - Room 205A

Service Productivity

Sponsor: Service Science

Sponsored Session

Chair: Elodie Adida, University of California at Riverside, elodie.goodman@ucr.edu

1 - Risks in Lean Service

Seong Dae Kim, Assistant Professor, University of Alaska Anchorage, 3211 Providence Drive, University Center Room 155, Anchorage, AK, 99508, United States of America, sdkim2@uaa.alaska.edu

The concept of Lean is originated from Toyota Production System (TPS), which is manufacturing industry oriented. The key principles and techniques are now applied to service sector in many different ways. Reducing cost might be easy but reducing cost while keeping or improving quality is a challenge due to the two conflicting goals. This research will identify risks associated with seeking for lean service and recommend how to deal with them.

2 - Adaptive Blending in Call Centers

Ger Koole, VU University Amsterdam, De Boelelaan 1081a, Amsterdam, Netherlands, ger.koole@vu.nl, Benjamin Legros, Oualid Jouini

We examine a model with inbound calls and emails. There is an infinite source of emails, calls arrive according to a non-homogeneous Poisson process. Non-preemptive priority is given to calls, emails are only assigned if the number of available agents exceeds a certain threshold level. The objective is to maximize the email throughput while satisfying a service level constraint for the inbound calls. We propose different adaptive methods to change the threshold and report on experiments.

3 - The Efficiency of Academic Departments at Universidad de La Frontera: A Multivariate-DEA Analysis

Karen Morales-Muñoz, Alumna Magìster en Sistemas de Gestiòn Integral de la Calidad, Universidad de La Frontera, Avenida Francisco Salazar 01145, Temuco, Chile, karenmoralesm@gmail.com, Ana Moraga-Pumarino, Sonia Salvo-Garrido, Martha Ramìrez-Valdivia

This work estimates the technical efficiency of 30 Academic Departments at Universidad de La Frontera by means of Data Envelopment Analysis. We use two scenarios to evaluate the effect different variables have on the performance of the Departments. The average efficiency score using a BCC-Output oriented model varies from 0.599 to 0.89. The main results imply that key variables are related to teaching and research. A Tobit model identifies the main factors that influence the efficiency score.

4 - Managing Long-term Supplier Relationship under Changing Productivity

Long Gao, Assistant Professor, UC Riverside, 221 AGSM, UCR, Riverside, United States of America, long.gao@ucr.edu, Elodie Adida

We study a procurement problem where the supplier's private productivity is dynamically evolving. The buyer commits to a long-term contract for profit-maximizing. We show that the optimal contract spreads out the needed distortions over time to limit information rents. The contract is asymptotically efficient and easy to implement.

■ MB18

Level 2 - Room 205B

Real Options/EDA

Sponsor: Service Science

Sponsored Session

Chair: Guiping Hu, Iowa State University, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu

1 - Group LASSO-based Variable Selection Method for Data Envelopment Analysis

Song Irene, Columbia University, Columbia University, 120 Street, New York, NY, 10027, United States of America, irene.j.song@gmail.com, Tony Qin

In this talk, we propose a data-driven variable selection method based on group least absolute shrinkage and selection operator (LASSO) for data envelopment analysis (DEA). We test our method against two of the most widely-used variable selection methods - efficiency contribution measure (ECM) and regression-based test - in DEA using Monte Carlo simulations and report on its performance, which compares favorably to that of the other two methods.

2 - Valuation of Fast Pyrolysis Pathway via Real Options Approach

Yihua Li, Iowa State University, Ames, IA, United States of America, yihuali@iastate.edu, Guiping Hu, Chung-Li Tseng

Biofuels have the potential to substitute petroleum fuels and reduce the U.S. dependency on imported petroleum. In this study, the investment decision making for advanced biofuel producers is investigated. The production pathway under investigation is fast pyrolysis of corn stover and upgrading to fuels. Stochasticity in biomass supply and biofuel demand is taken into consideration. Real option approach is used to evaluate the investment strategies. A case study in Iowa is presented.

3 - Digital Service Flexibility: Implications for Performance

Terence Saldanha, Assistant Professor of Information Systems, Emporia State University, 1200 Commercial Street, Cremer Hall, Room 110, Emporia, KS, 66801, United States of America, tsaldanh@emporia.edu, Jiban Khuntia, Abhishek Kathuria

We investigate how digital service flexibility (DSF) influences performance of credit unions. We identify three dimensions of DSF: basic DSF, transaction DSF, customer DSF. We theorize a complementary effect of transaction DSF, and negative moderation effect of customer DSF on the relationship between basic DSF and performance. Using archival data collected from the annual reports of credit unions across the United States, we find empirical support for the hypothesized relationships.

■ MB19

Level 2 - Room 205C

Advances in Applied Probability and Monte Carlo Methods

Sponsor: Applied Probability

Sponsored Session

Chair: Jose Blanchet, Professor, Columbia University, 500W 120th Street, New York, NY, United States of America, jose.blanchet@columbia.edu

1 - Stochastic Root Finding with the Probabilistic Bisection Algorithm

Shane Henderson, Cornell University, School of ORIE, 230 Rhodes Hall, Ithaca, NY, United States of America, sgh9@cornell.edu, Peter Frazier, Rolf Waeber

The probabilistic bisection algorithm finds the root of a monotone function on [0, 1] when noisy function evaluations are available. It successively updates a prior distribution on the location of the root. In doing so, it needs to know the probability that the sign of the noisy function evaluation is correct. We explore a method for circumventing this problem and develop convergence results.

2 - Simulation of Extremes of a Gaussian Vector

Ton Dieker, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, United States of America, ton.dieker@isye.gatech.edu, Benjamin Yakir, Richard Birge

We devise and analyze an efficient Monte Carlo algorithm for computing the probability that the maximum of a Gaussian vector exceeds a certain level-crossing parameter x. This is a rare event when x is large, so direct Monte Carlo quickly becomes prohibitive. We design an estimator with low variance which is asymptotically independent of the parameter x in certain asymptotic regimes, leading to so-called strong efficiency. This approach has already been used to resolve an open problem in the theory of simulation of Gaussian processes, and could be of interest for other simulation problems.

3 - State-Independent Importance Sampling for Heavy Tailed Random Walks

Sandeep Juneja, Professor, Tata Institute of Fundamental Research, HB Road, Colaba, Mumbai, 400005, India, juneja@tifr.res.in, Karthyek Rajhaa Anna Murthy, Jose Blanchet

We consider two popular rare event probabilities associated with random walks: Large deviations as well as level crossing probabilities when the increments have regularly varying tails. We challenge the prevailing view that complex state-dependent methods are needed for their efficient simulation by developing simpler state-independent methods that have asymptotically vanishing relative error. Numerically the proposed methods perform better than the existing ones.

4 - Robust Assessment of Dependency

Henry Lam, Assistant Professor, Boston University, 111 Cummington Street, Boston, MA, 02215, United States of America, khhlam@gmail.com

We propose a general nonparametric framework to gauge the local effect of serial dependency in the input model on stochastic simulation. The key instrument is an optimization formulation on the mutual information of the underlying input distributions. The associated optimal values form a basis for constructing output confidence intervals, and connect to analysis-of-variance (ANOVA) estimators which can be efficiently computed.

■ MB20

Level 2 - Room 205D

Dynamic Control & Real Options Applications

Sponsor: Applied Probability

Sponsored Session

Chair: Nur Sunar, Stanford University, Knight Management Center, Stanford, CA, 94305, United States of America, Sunar_Nur@gsb.stanford.edu

1 - Investment Timing with Incomplete Information and Multiple Means of Learning

Nur Sunar, Stanford University, Knight Management Center, Stanford, CA, 94305, United States of America, Sunar_Nur@gsb.stanford.edu, J. Michael Harrison

Motivated by applications in oil exploration and investment, we consider a firm that can use one of several costly learning modes to dynamically explore the economic viability of a project. In addition to dynamic decisions about its learning mode, the firm must decide when to stop learning and either invest or abandon the project. Using a continuous-time Bayesian framework, we solve both the discounted and undiscounted versions of this problem.

2 - Value of Flexibility in Oil and Gas Projects; The Case of Deferral Options

Babak Jafarizadeh, Statoil, Svanholmen 8, Sandnes, 4313, Norway, bajaf@statoil.com

The timing flexibility of investments may entail extra value for oil and gas companies. However, the extent of such value creation has not been previously explored in detail. In this paper, we discuss investments with long or short-term outcome realizations and conclude that the value of deferral options tend to be higher for decisions with an earlier outcome realization.

3 - An Approximate Dynamic Programming Algorithm for Optimal Bidding in the Real-time Electricity Market

Daniel Jiang, PhD Student, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, drjiang@princeton.edu, Warren Powell

There is growing interest in the use of grid-level storage to smooth variations in the loads that are likely to arise with increased use of wind and solar energy. Battery arbitrage is becoming an important way of paying for investments into grid level storage. We formulate the problem using the dynamic programming framework, show several structural properties of the optimal value functions, and apply the techniques of approximate dynamic programming (ADP) to find a profitable bidding policy.

4 - Dynamic Optimal Pricing and Platform Evolution

Sinit Vitavasiri, PhD Candidate, Stanford University, Knight Management Center, Stanford, CA, 94305, United States of America, sinit@stanford.edu

I introduce a dynamic framework to analyze platform's optimal pricing strategy for a network product. In the Markov perfect equilibrium, the platform's market power is weakened by the network effect and the damage to future sale. The intensity of the network effect and the ability to commit to a future price path determine the optimal pricing rule, the long-run distribution of the market share, and the risk of failure to launch.

■ MB21

Level 2 - Room 206

Optimization Models in Disease Prevention and Treatment

Sponsor: Health Applications

Sponsored Session

Chair: Fan Wang, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, United States of America, fxw005@uark.edu

Co-Chair: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering, Fayetteville, AR, 72704, United States of America, shengfan@uark.edu

1 - Optimal Screening Strategies of Patients on the Kidney Transplant Waiting List

Alireza Sabouri, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, Alireza.Sabouri@sauder.ubc.ca, Steven Shechter, Tim Huh

The health condition of patients on the kidney transplant waiting list deteriorates while they are waiting for an organ arrival and hence they may no longer be suitable for transplant. Therefore, transplant centers screen waiting patients at various intervals to identify ineligible patients. We propose a model for finding screening strategies that minimizes the expected screening cost and the expected penalty cost associated with transplanting an organ to an ineligible patient.

2 - A Stochastic Nonlinear Programming Model for Mammography Screening Policies Considering Adherence

Mahboubeh Madadi, University of Arkansas, Fayetteville, AR, United States of America, mmadadi@email.uark.edu, Shengfan Zhang

Mammography screening policies have been the subject of significant debate in recent years. However, earlier studies on breast cancer screening policies did not take women's adherence behaviors into consideration. In this study, a nonlinear integer programming model is developed to find the optimal screening mammography policies in terms of the likelihood of detecting breast cancer in its preclinical stage while incorporating variation in women's compliance behaviors.

3 - Optimization of Surveillance Strategies for Secondary Renal Cell Carcinoma

Jennifer Mason, Assistant Professor, University of Virginia, PO Box 800717, Charlottesville, VA, 22908, United States of America, jem4yb@virginia.edu, Tracey Krupski

Renal cell carcinoma is the most common form of kidney cancer, often requiring surgical removal of part or the entire affected kidney. After surgery patients are at risk for recurrence. We use our Monte Carlo simulation model to optimize surveillance strategies for recurrence considering objectives including minimizing cost, minimizing time to recurrence diagnosis, and minimizing radiation exposure. We present numerical results comparing the optimal strategies to published guidelines.

4 - Optimizing Breast Cancer Mammography Screening Schedules using a Regression-based Model

Fan Wang, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, United States of America, fxw005@uark.edu, Shengfan Zhang

We formulate multiple generalized linear models to predict breast cancer probabilities for women with various backgrounds, in order to provide decision aids on mammography screening schedules. The independent covariates include various breast cancer risk factors. H measure is used to select the best model. We use the misclassification cost term criterion to calculate the optimal age-specific cut-off points of cancer probabilities for accepting a mammogram with the least loss of life expectancy.

■ MB22

Level 2 - Room 207

Decision Making Tools with Limited Information

Cluster: Healthcare Systems/Informatics

Invited Session

Chair: Sarah Nurre, Assistant Professor, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Sarah.Nurre@afit.edu

1 - Optimizing Schedules for Prophylaxis with Antibodies

Alexander Gutfraind, University of Illinois at Chicago, 1603 W. Taylor Street Rm. 834, MC 923, Chicago, Il, 60612, United States of America, agutfrai@uic.edu, Alison P. Galvani, Lauren A. Meyers

Prophylaxis with synthetic antibodies can protect against infections when no vaccine is available. Such a treatment could be lifesaving but also expensive. We examined the case of Palivizumab, which targets the Respiratory Syncytial Virus in high-risk infants. We show how optimization of the treatment schedule could improve the effectiveness of the treatment by 5-22% depending on the location in the US, or reduce its cost by up to 20%.

2 - Online Integrated Network Design and Scheduling Problems with Flexible Release Dates

Sarah Nurre, Assistant Professor, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, OH, 45433, United States of America, Sarah.Nurre@afit.edu, Thomas Sharkey

We consider the problem of allocating resources to tasks within a network over time. The motivating application is repairing damaged infrastructure components after an extreme event. Each task has an associated release date, which can be shifted earlier in time by allocating special resources to it. We discuss an online optimization setting where the release dates are not known, dispatching rules to determine the allocation of resources to tasks, and promising computational results.

■ MB23

Level 2 - Room 208A

Revenue Management & Pricing: Modeling and Empirical Perspectives

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Benny Mantin, University of Waterloo, 200 University Avenue W, Waterloo, ON, N2L3G1, Canada, bmantin@uwaterloo.ca

1 - Optimal Bundling with Dependent Valuations

Fredrik Odegaard, Ivey Business School, Western University, London, ON, Canada, fodegaard@ivey.uwo.ca, Mihai Banciu

Bundling together two or more separate products and selling as a whole, is a prevalent industry and revenue management practice, e.g. airlines offering add-on services. In this talk, we introduce a novel approach of pricing bundles which explicitly addresses the relationship between the individual valuations of the components. We contrast our approach with the typical assumption of independent valuations and discuss the revenue implications of ignoring dependence.

2 - Strategic Consumers, Myopic Retailers

Anton Ovchinnikov, University of Virginia, Darden School of Business, 100 Darden Blvd, Charlottesville, VA, United States of America, Ovchinnikova@darden.virginia.edu, Mirko Kremer, Benny Mantin

We study competitive dynamic pricing with strategic consumers. We present a stylized two-period model, followed by a set of behavioral experiments. Our main insight is that subject behaved myopically: they price so that to obtain higher revenue and sell more inventory in the main selling season, but by doing so significantly limit their ability to generate revenue in the clearance season, which, in the presence of strategic consumers is a major source of revenue.

3 - Bargaining for Supply Chain Revenue Allocation

Dror Hermel, Ariel University, Ariel, Israel, Dror.Hermel@sauder.ubc.ca, Daniel Granot, Mahesh Nagarajan

We present a negotiation model to arrive at profit sharing in a supply chain with a pivotal agent who interacts with N non-pivotal agents, which may or may not communicate among themselves. We arrive at an allocation, using NBS and an endogenously generated disagreement outcome. For non-communicating settings it constitutes a Nash-Nash equilibrium. For a communicating setting our allocation, surprisingly, equals the Shapley value of a related cooperative game.

4 - On the Effect of Strategic Consumer Behavior: Pricing Evidence from the Airline Industry

Benny Mantin, University of Waterloo, 200 University Avenue W, Waterloo, ON, N2L3G1, Canada, bmantin@uwaterloo.ca, Eran Rubin

Online decision support systems that provide consumers with information about future distributions of prices can facilitate strategic consumer behavior. We empirically demonstrate the magnitude effects of strategic consumer behavior in the context of the airline industry. We find that the availability of such information is associated with lower transacted airfares.

■ MB24

Level 2 - Room 208B

Modeling Demand in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Nishant Mishra, Rotterdam School of Management, Erasmus University, Rotterdam, Netherlands, nmishra@rsm.nl

1 - A Choice-based Non-parametric Method of Demand Modeling in Revenue Management

Shadi Sharif Azadeh, Polytechnique Montreal, Apt. 108, 50 Willowdale, Outremont, Montreal, No, H3T 1G1, Canada, shadi.sharifazadeh@polymtl.ca, Patrice Marcotte, Gilles Savard

In transportation companies, demand forecasting is crucial. To maximize revenue, these systems use historical data. However, due to booking limits, registered reservations do not represent the real demand. We represent a non-parametric approach which is able to model demand by using choice probabilities. Our proposed model is able to extract seasonal features of demand and customer utilities for a given product. The precision of results has been verified by both synthetic and real data.

2 - Bid Prices for the Network Revenue Management Problem with Non-parametric Choice Models

Marco Bijvank, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, mbijvank@rsm.nl, Alwin Haensel

One of the main issues in revenue management involves deciding which products to offer customers during the booking horizon in order to maximize revenue. We develop new efficient mathematical programming methods to compute bid prices, where we include two trends: customers request products according to non-parametric choice models with overlapping consideration sets and bid prices change over time. Another advantage of our formulation is that it uses the appealing simplicity of DLP.

3 - Prudent Pricing for Sequential Sales

Xiaowei Xu, Associate Professor, Rutgers Business School, 1 Washington Park, RM 958, Newark, NJ, 07102, United States of America, xiaoweix@business.rutgers.edu

This paper studies a multi-stage dynamic pricing model, in which a state variable evolves as a stochastic process and affects price-sensitive customer demand at each stage. A firm has a limited amount of inventory to liquidate and sets the price at each stage after observing the state variable. We study a prudent pricing strategy to sell the stock sequentially. The optimality of such a pricing strategy depends on the curvature of the marginal revenue function.

■ MB25

Level 2 - Room 208C

Bidder Behavior in the Lab and in the Field

Cluster: Auctions

Invited Session

Chair: Pallab Sanyal, Assistant Professor, George Mason University, 4400 University Dr, MS 5F4, Fairfax, VA, 22030, United States of America, psanyal@gmu.edu

1 - Collaboration, Interdependency, and Transfer Pricing

Matthew Hashim, Assistant Professor, The University of Arizona, Tucson, AZ, United States of America, mhashim@email.arizona.edu, Karthik Kannan

In resource sharing contexts such as peer-to-peer to caching, information security over a cloud infrastructure, etc., rational agents have been theoretically shown to attain social optimality through auctions. Using a similar context, we conduct a lab experiment to evaluate how well the social welfare turns out to be when agents are allowed to bargain under various levels of uncertainty. We also subsequently study the performances of the auction mechanism to attain social-optimality.

2 - A Study of Bidding Behavior in All-pay Auctions
Peter Popkowski Leszczyc, University of Alberta, Edmonton, AB, Canada, ppopkows@ualberta.ca, Ernan Haruvy

In a field study, we investigate bidding strategies and revenue implications in simultaneous paired identical products auctions for winner-pay and all-pay formats in charity and non-charity settings. We find evidence that bidders in all-pay auctions use rational bidding strategies that are effective in these settings such as early jump bidding and late incremental bidding. However, the all-pay format generated substantially higher revenue, in particular in a charity setting.

3 - Spectrum Auction Design - Simple Auctions for Complex Sales
Martin Bichler, Professor, Technische Universität München, Munich, Germany, mar.bichler@gmail.com, Jacob Goeree, Stefan Mayer, Pasha Shabalin

We analyze the impact of two main design choices that spectrum auction designers face in lab experiments: simple "compact" bid languages versus "fully expressive" bid languages and simple "pay-as-bid" payment rules versus "bidder-optimal core-selecting" payment rules. We find that simplicity of the bid language has a substantial positive impact on the auction's efficiency and that simplicity of the pricing rule has as a significant impact on revenue.

■ MB26

Level 2 - Room 208D

Urban Operations Research

Sponsor: Location Analysis

Sponsored Session

Chair: Mihiro Sasaki, Associate Professor, Nanzan University, 27 Seirei, Seto, 489-0863, Japan, mihiro@nanzan-u.ac.jp

1 - Density of Alternative Fuel Stations and Refueling Availability
Masashi Miyagawa, University of Yamanashi, 4-4-37 Takeda, Kofu, 400-8510, Japan, mmiyagawa@yamanashi.ac.jp

This paper develops an analytical model for determining sufficient density of alternative fuel stations required to achieve a certain level of service. The service level is represented as the probability that the vehicle can make the repeated round trip between randomly selected origin and destination. The probability demonstrates how the density of stations, the vehicle range, the trip length, and the refueling availability at origin and destination affect the service level.

2 - Determining the Number of Battery Stations and that of Pits for EVs Based on Japanese Networks
Yudai Honma, Waseda University, 60-02-05A, Okubo 3-4-1, Shinjuku, Tokyo, Japan, yudai@aoni.waseda.jp, Shigeki Toriumi

Electric vehicles (EV) have attracted an increasing amount of attention. However, the continuous cruising distance of an EV is insufficient for everyday use. Battery capacity is the limiting factor in long-distance EV travel. In planning the EV infrastructure, an appropriate number of EV stations and chargers must be installed. In this study, we propose a mathematical model for estimating the number of stations and that of pits in Japanese road networks.

3 - Dynamic Long-Term Planning of Ambulance Locations and Assignments
Oleksandr Shlakhter, Senior Researcher, Alberta Health Services, Edmonton, AB, Canada, alex.shlakhter@rotman.utoronto.ca, Dmitry Krass

We present new perspectives on the problem of long-term planning of emergency medical services, including station locations and resource assignments. Available approaches are reviewed and a new approach is formulated. The model allows for dynamic multi-year resource planning.

4 - Hospital Bed Reallocation Problems to Improve Accessibility for Patients
Mihiro Sasaki, Associate Professor, Nanzan University, 27 Seirei, Seto, 489-0863, Japan, mihiro@nanzan-u.ac.jp, Takamori Ukai

In recent years, some regions in Japan have been faced with a severe shortage of medical resources while some others have enough capacity. The size of such imbalances are different in each medical district or type of disease, and directly affects the accessibility for patients to hospitals. One of the major reasons that causes these imbalances is a mismatch between supply and demand. In this paper, we propose mathematical models for reallocating resources so as to reduce accessibility imbalance.

■ MB27

Level 2 - Room 209A

MAS Session II

Sponsor: Military Applications

Sponsored Session

Chair: William Fox, Naval Postgraduate School, 589 Dyer Road, Room 214, Monterey, CA, 93943, United States of America, wpfox@nps.edu

1 - Narrative Analysis in Support of a Rapid Fielding Process
Michael Jaye, Naval Postgraduate School, Monterey, CA, United States of America, Mjjaye@nps.edu, Donnie Choe, Vic Diaz`, Anthony Keller

The Warfighter Technology Tradespace Methodolgy applies technology acceptance theories to rapid fielding activities which focus on working with developers to gather system data relative to warfighter expectations in several dimensions. Collecting and analyzing soldier end user narratives can inform that process: we gathered soldier narratives to create multiple sense-making items which can be used to provide quantitative research material as well as impact analysis thereby informing the process.

2 - Optimally Stationing and/or Reducing the US Military using a Mixed Integer Linear Program (MILP)
Michael Teter, Major, USA, Colorado School of Mines, 1500 Illinios Ave., Golden, CO, 80401, United States of America, mteter@mines.edu

The Unit Stationing and Reduction Model optimally stations and/or reduces the United States Military over a given time horizon while meeting operational, personnel, facility, range, flight line and/or budgetary constraints. This model has been validated over several data sets including the last Base Realignment And Closure (BRAC) from 2005.

■ MB28

Level 2 - Room 209B

Estimators

Cluster: Data Envelopment Analysis

Invited Session

Chair: Ole Bent Olesen, Professor, University of Southern Denmark, Campusvej 55, Odense M, DK5230, Denmark, ole@sam.sdu.dk

1 - Flexible Aggregation in Output Homothetic Production (Coauthor N.C. Petersen)
Ole Bent Olesen, Professor, University of Southern Denmark, Campusvej 55, Odense M, DK5230, Denmark, ole@sam.sdu.dk

The standard approach of cost efficiency estimation of hospital uses common tariffs. More than one set of tariffs are suggested for the estimation of a number of homothetic sub-technologies in the relevant subspaces of the full output space. Methods for combining these homothetic sub-technologies into homothetic overall technology are suggested. Assuming homothetic structures with a common scaling law (not necessarily CRS) is shown to provide a link.

2 - Relative Prices, Trade, Technology and Wage Inequality - Evidence from India
Somesh Mathur, HSS,IITK, Kanpur, India, skmathur@iitk.ac.in, Archana Srivastava

The paper examines the link between relative export, import and domestic goods prices and relative wages over the years by empirically testing the Stolper Samuelson theorem for India. The paper also examines the role of other factors such as manufacturing trade, liberalization phase, inflation, foreign and domestic technology etc., on rising wage inequality in the manufacturing sector of India. The results seem to prove the validity of Stolper Samuelson theorem. Along with Stolper Samuelson theorem, it also throws some light on Rybczynski theorem which shows the relationship between output and endowment and factor price insensitivity elasticity which shows the link between factor endowments and factor prices. The empirical testing is done using estimates of the translog production function and translog cost function along with the share equations. Elasticity of substitution between factors of production has been worked out using Allens' and Morishma formulae which in turn uses estimates of the translog Cost Function.

3 - Technical Efficiency of Jute Farmers in Bangladesh
Subir Bairagi, PhD Student, University of Nebraska Lincoln, 314E Filley Hall, Lincoln, NE, 68583, United States of America, subirkanti105@gmail.com, Uttam Deb

Technical efficiency of 259 Jute farmers in Bangladesh is measured using a non-parametric approach (O'Donnell index). Single output and four inputs are used, gathered from CPD field survey. The result shows that the mean efficiency is about 0.54. In the 2nd stage, a Tobit model will be used to identify the factors responsible for technical inefficiency in jute farming in Bangladesh.

4 - Solving Large-scale DEA Problems by using Small Samples
Wen-Chih Chen, Associate Professor, National Chiao Tung University, 1001 Ta Hsueh Rd., Hsinchu, Taiwan - ROC, wenchih@faculty.nctu.edu.tw

We present an algorithm for solving larger-scale DEA problems by using small size samples. We are able to control the size of individual LP problems under a prespecified limit while maintaining the solution quality.

■ MB29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Gurobi Optimization - Gurobi Compute Server, Distributed Tuning Tool and Distributed Concurrent MIP Solver
Zonghao Gu, Gurobi Optimization Inc., 3733-1 Westheimer Rd., #1001, Houston, TX, 77027, United States of America, gu@gurobi.com

We will present the Gurobi Compute Server, which allows you to seamlessly offload your optimization computations onto one or more dedicated optimization servers. We will also discuss the design and features of Gurobi Compute Server, and how to use it to build and deploy an application locally or in the cloud. Lastly, we will talk about our distributed features based on the Gurobi Compute Server, such as our new distributed automatic parameter tuning tool and distributed concurrent MIP solver.

2 - AIMMS (Paragon Decision Technology) - AIMMS for Advanced Optimization
Bobby Nyotta, AIMMS (Paragon Decision Technology), 500 108th Ave NE Suite 1780, Bellevue, WA, 98004, United States of America, b.nyotta@aimms.com, Deanne Zhang

This demo will concentrate on how AIMMS can help you solve complicated optimization models using prebuilt building blocks to meet customized requirements. We will demonstrate the AIMMS' Benders Decomposition library for large MIP models and AIMMS' Outer Approximation algorithm for MINLP models. We will also show you how to use the "straight out of the box" tools. These advanced algorithms in AIMMS will give you the power and flexibility to tackle the most complicated problems. More information is available at aimms.com/workshops.

■ MB31

Level 2 - Room 211A

Best of Women in OR/MS: Papers in Top OR Journals Presented by their Women Authors

Sponsor: Women in OR/MS

Sponsored Session

Chair: Laura McLay, Associate Professor, University of Wisconsin-Madison, Industrial & Systems Engineering, Madison, WI, 53706, United States of America, lmclay@wisc.edu

Co-Chair: Guzin Bayraksan, The Ohio State University, Integrated Systems Engineering, Columbus, OH, United States of America, bayraksan.1@osu.edu

1 - A Sequential Sampling Procedure for Stochastic Programming
Guzin Bayraksan, The Ohio State University, Integrated Systems Engineering, Columbus, OH, United States of America, bayraksan.1@osu.edu, David Morton

We present a sequential sampling procedure for a class of stochastic programs. The procedure takes as input a sequence of candidate solutions and generates an optimality gap estimate with increasing sample size. We discuss rules to stop the procedure and increase the sample size. We provide conditions under which this procedure (i) terminates with probability one and (ii) terminates with a solution that has a small optimality gap with a prespecified probability and present computational results.

2 - Network Design and Allocation Mechanisms for Carrier Alliances in Liner Shipping
Ozlem Ergun, H. Milton Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, oergun@isye.gatech.edu, Richa Agarwal

Many real world systems operate in a decentralized manner. We study transportation networks that operate as an alliance. In particular, we study alliance formation among carriers in liner shipping. We utilize optimization and game theory concepts and design a mechanism to guide the carriers in an alliance to pursue an optimal collaborative strategy. The mechanism provides side payments to the carriers motivating them to act in the alliance best interest while maximizing their own profits.

3 - Pricing Games and Impact of Private Demand Information in Decentralized Assembly Systems
Basak Kalkanci, Massachusetts Institute of Technology, Boston, MA, United States of America, kalkanci@mit.edu, Feryal Erhun

We reveal new insights on the value of contract type (price-only versus complex), demand information and contract sequence to different players in decentralized assembly systems under asymmetric demand information. We find that individual suppliers do not necessarily benefit from a complex contracting equilibrium and a downstream supplier may prefer information asymmetry, especially under moderate demand variability. Unless there is a high demand risk, the first-mover advantage is prevalent.

■ MB32

Level 2 - Room 211B

Emerging Scholars in Technology Management

Sponsor: Technology Management

Sponsored Session

Chair: Leonardo Santiago, Associate Professor, Federal University of Minas Gerais, Escola de Engenharia da UFMG, Av. Antônio Carlos, 6627 - Pampulha, Belo Horizonte, MG, 31270-901, Brazil, lsantiago@ufmg.br

1 - Complementary Capabilities in Dynamic Environments: The Evolution of Services in IT Product Firms
Phillip Anderson, Assistant Professor, University of Illinois, Urbana-Champaign, 1206 S. 6th Street, Champaign, IL, United States of America, philca@illinois.edu

This dissertation explores the fast-paced IT product industry that rewards firms for innovation and fast growth, yet some firms have altered their strategic positioning in services as exhibited by a few multibillion dollar acquisitions in recent years. This signal suggests that the innovator has strategic options beyond the classic product-process innovation models. With data on 300+ firms from 1987-2008 and two case studies, I examine how this services phenomenon emerges and evolves.

2 - Industry Location Shift through Technological Change - A Study of the U.S. Semiconductor Industry
Jon Kowalski, Associate, McKinsey & Co., 4030 Hoosac St., Pittsburgh, PA, 15207, United States of America, jon@jonkowalski.com

Silicon Valley is a storied region regarded as a model for economic development. Many governments have attempted to re-create the success of Silicon Valley. However, it is not clear that we know what led to the region's success, as existing work has not pursued industry-wide firm-level analyses to examine such mechanisms. This work seeks to begin to address this literature gap in order to better inform regional economic development policy moving forward.

3 - From Idea to Product – Translating Knowledge between the Lab and the Clinic
Ayfer Ali, Universidad Carlos III de Madrid, Madrid, Spain, aali@emp.uc3m.es

In my research I explore knowledge translation from the laboratory bench to the clinic and back. Using patent and licensing data from two of the largest Academic Medical Centers in the US, I explore team knowledge composition and its influence on translation. I also explore the demand side of markets for technology and the importance of existing technology on the decision to in-license an invention.

■ MB33

Level 2 - Room 211C

Railroad Predictive Analytics

Sponsor: Railway Applications

Sponsored Session

Chair: Aihong Wen, Manager of Operations Research, CSX Transportation, 500 Water St., Jacksonville, FL, 32202, United States of America, Aihong_Wen@csx.com

1 - Predictive Maintenance for Railroad MoW Vehicles

Aihong Wen, Manager of Operations Research, CSX Transportation, 500 Water St., Jacksonville, FL, 32202, United States of America, Aihong_Wen@csx.com, Kin-Ming Kam

Predictive maintenance offers cost savings over routine or time-based preventive maintenance. This presentation discusses how data mining techniques can be used to enable railroads practice predictive maintenance for the Maintenance of Way vehicle fleet by finding associated repair items.

2 - Prediction of Railcar Remaining Life by Multiple Data Source Fusion

Qing He, SUNY Buffalo, 313 Bell Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu, Zhiguo Li

Nowadays railway network are instrumented with various wayside detectors. Previous railcar failure prediction method only utilizes single data source, such as wheel impact load detector (WILD). In this work, we present a methodology to fuse data from a variety of detectors, such as WILD, machine vision (MV), and optical geometry detector (OGD). Several data mining techniques are implemented and compared to predict the remaining life of railcar components in a national wide railway network.

3 - Predict Congestion Status of a Hump Yard using Data-mining

Yu Wang, Manager OR-Simulation, CSX, 500 Water St., J300, Jacksonville, FL, 32202, United States of America, yu_wang@csx.com, Aihong Wen

The objective of this project is to utilize data mining techniques to predict the near future status of a hump yard and to pinpoint the leading factors of yard congestion. The motivation of this research is to provide insights to yard operation teams as well as resource providers so that they can be proactive in solving congestion issues. The experiences obtained from this research would lay down a foundation for future dynamic service planning system development.

■ MB34

Level 2 - Room 211D

Simulation Society and QSR Joint Session

Sponsor: Simulation Society & Quality, Statistics and Reliability

Sponsored Session

Chair: Hong Wan, Purdue University, 315 N. Grant St., West Lafayette, IN, 47906, United States of America, hwan@purdue.edu

Co-Chair: Feng Yang, Assistant Professor, West Virginia University, PO Box 6070, Morgantown, WV, 26506, United States of America, Feng.Yang@mail.wvu.edu

1 - Simulation Screening Experiments using LASSO-optimal Supersaturated Design and Analysis: A Maritime Operations Application

Dadi Xing, Purdue University, 134 Nimitz Dr. Apt. 8, West Lafayette, In, 47906-3357, United States of America, dxing@purdue.edu, Hong Wan, Yu Zhu, Turgut Kaymal, Susan Sanchez

Lasso is a popular method for variable selection. Based on the correct selection probabilities of LASSO with finite samples, we proposed new criteria to generate supersaturated design and algorithm to select the optimal tuning parameters for LASSO model selection. We apply this new method to an agent-based simulation of maritime escort operations, and compare the results with Cross Validation, AIC, and BIC. Our numerical evaluation shows that our new method is more efficient and flexible.

2 - An Efficient Statistical Procedure for Multivariate Calibration of Sensor Arrays

Zongyu Geng, West Virginia University, P.O.Box 6070, Morgantown, United States of America, zygeng@gmail.com, Feng Yang, Minqi Li, Nianqiang Wu

One of the major challenges of calibrating a sensor array lies in the typically large samples required to estimate a high-quality multivariate calibration (MC) model, which functionally relates the array responses to the analyte concentrations. This work develops a multi-stage procedure to guide the optimal sampling in a sequential manner. The design optimization at each stage seeks to optimize the quality of the MC model, and is performed based on the new statistical inference method.

3 - Recent Breakthroughs in Large-scale Simulation Experiments

Susan Sanchez, Naval Postgraduate School, 1411 Cunningham Rd., Monterey, CA, 93943, United States of America, smsanche@nps.edu

Designed experiments are powerful ways to gain insights into the behavior of complex simulation models. In recent years, many new designs have been created to address the large number of factors and complex response surfaces that often arise in simulation studies. These include procedures capable of handling discrete-valued or qualitative factors. We describe some of these advances, and summarize the results of utilizing large-scale designed experiments for several defense simulation studies.

4 - Dynamic Acceptance Sampling Plans in a Supply Chain with Endogenous Product Quality

Tian Ni, PhD Student, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, ni10@purdue.edu, Xiaowei Xu, Hong Wan

This article studies a firm that procures a product from a supplier in a repeated setting. In each period, based on the historical public information the firm determines the optimal acceptance sampling plan and the supplier strategically determines the quality effort level. Internal product failure and external product failure coexist in our model. Sufficient conditions that guarantee the existence of Nash equilibrium are also provided.

5 - ARD: An Automated Replication-Deletion Method for Simulation Analysis

Emily K. Lada, SAS Institute, United States of America, Emily.Lada@sas.com, Anup Mokashi, James Wilson

ARD is an automated replication-deletion procedure for computing point and confidence interval (CI) estimators for the steady-state mean of a simulation-generated output process. In an extensive experimental performance evaluation, ARD's CIs closely conformed to given coverage and precision requirements but generally required a larger computing budget than single-run procedures.

■ MB35

Level 2 - Room 212A

Economics of Online Platforms

Sponsor: E-Business

Sponsored Session

Chair: Mingdi Xin, University of California-Irvine, Paul Merage School of Business, Irvine, CA, United States of America, mingdi.xin@uci.edu

1 - Product Line Design in e-Commerce Marketplaces

Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 4800 Forbes Avenue, Hamburg Hall, Pittsburgh, PA, 15213, United States of America, vibs@andrew.cmu.edu

There has been an emergence of online Marketplaces that allow suppliers to use the retailer's online infrastructure to sell products directly to consumers. We consider a marketplace for vertically differentiated goods with heterogeneous consumers. Our analysis suggests that the quality offered to the high-type customers when the supplier sells through a marketplace is always lower than the first-best quality. We further show that the product line always becomes shorter in this marketplace.

2 - Cloud Implications on Software Network Structure and Security Risks

Terrence August, University of California-San Diego, 9500 Gilman Drive MC 0553, Otterson Hall 3S-146, La Jolla, CA, 92093-0553, United States of America, taugust@ucsd.edu, Marius Florin Niculescu, Hyoduk Shin

By software vendors offering, via the cloud, software as a service (SaaS) versions of traditionally on-premises products, security risks associated with software usage become more diversified which can greatly increase the value associated with network software. In an environment where negative security externalities are present and users make complex consumption and patching decisions, we construct a model that clarifies whether and how SaaS versions should be offered by vendors.

3 - Competing Auctions in Online Advertising

De Liu, University of Kentucky, 425D Gatton B&E Building, Lexington, KY, 40506, United States of America, de.liu@uky.edu, Jianqing Chen, Andrew Whinston

What happens when there are competing offerings of keyword auctions? We moves beyond a monopolistic setting to study two simultaneous keyword auctions that may differ in their ranking rules. Under this framework, we examine the effect of competing auctions on advertisers' participation, the optimal design of keyword auctions, and social welfare.

■ MB36

Level 2 - Room 212B

OR Models for Disease Management and Public Health Policy

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Shan Liu, Assistant Professor, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, shanliu@stanford.edu

1 - Building Prediction Models for Colorectal Cancer Mortality

Leila Zia, Stanford University, United States of America, leilaz@stanford.edu, Kim Rhoads, Margrét Bjarnadòttir

We build prediction models for colorectal cancer mortality over a horizon of 30 days to 5 years after tumor diagnosis considering comprehensive medical, socio-economical, and hospital discharge data. We use two major California data-sets along with modern statistical methods such as classification trees and regularized logistic regression to find the most important predictors of colorectcal cancer mortality. We share insights which can help decision makers in the use of such prediction models.

2 - Capacity Management and Patient Scheduling Considering Reschedules, Cancellations, and No-Shows

Gokce Akin, Ph.D. Student, North Carolina State University, 2152 Burlington Labs, 2500 Stinson Drive, Raleigh, NC, 27695-7913, United States of America, gakin@ncsu.edu, Thomas Rohleder, Julie Ivy, Todd Huschka

We consider an outpatient clinic with demand from multiple patient classes with different demand rates; revenues; and behavioral functions for rescheduling, cancelling, or no shows each of which depends on appointment delay (i.e., time between the appointment request and the actual appointment). We develop a mathematical programming model to find the optimal appointment delay for each patient class, so that the net revenue is maximized subject to clinic daily capacity constraints.

3 - Optimizing Patient Treatment Decisions in an Era of Rapid Technological Advances

Shan Liu, Assistant Professor, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, shanliu@stanford.edu, Jeremy Goldhaber-Fiebert, Margaret Brandeau

How long should a patient with a treatable chronic disease wait for more effective treatments before accepting the best available treatment? We explore this question as an optimal stopping problem using a discrete-time, finite-horizon Markov Decision Process. We derive structural properties of the model, solve a three-period problem and present a numerical example of chronic hepatitis C optimal treatment adoption decisions.

4 - Identifying Changes In India's Tuberculosis Epidemic using Calibrated Microsimulation

Sze-chuan Suen, Stanford University, 117 Encina Commons, Stanford, CA, 94305, United States of America, ssuen@stanford.edu, Eran Bendavid, Jeremy Goldhaber-Fiebert

We built a dynamic transmission microsimulation of TB in India. The model incorporates treatment algorithms and empirically observed coverage and treatment uptake, and individuals are characterized by demographic and disease characteristics. We calibrated the model to demographic patterns and epidemiological data. We find that Indian drug resistant TB is transitioning from being primarily treatment- to transmission-generated, and we explore disease control implications of this change.

5 - Statistical Methods to Support Microsimulations of Anemia Reduction Interventions in Rural China

Diana Negoescu, Stanford University, negoescu@stanford.edu, Marcos Vera-Hernandez, Grant Miller, Sean Sylvia, Jeremy Goldhaber-Fiebert, Renfu Luo

Biomarkers predict disease risk and are potential intervention targets. They present modeling challenges because they are often non-Gaussian distributed, correlated with other individual characteristics, evolving over time with non-linear dependencies on their covariates, and related non-linearly to multiple health outcomes. We develop appropriate estimation procedures and apply them in a microsimulation of hemoglobin and anemia-related outcomes in rural Chinese schoolchildren.

■ MB37

Level 2 - Room 213A

Scheduling and Applications

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Hui-Chih Hung, Assistant Professor, National Chiao Tung University, 1001 University Road, Management Bldg. 2, IEM, Hsin-Chu, 300, Taiwan - ROC, hhc@nctu.edu.tw

1 - Appointment Sequencing with Equally Spaced Appointment Times

Boray Huang, National University of Singapore, 1 Engineering Drive 2, E1A-06-25, Singapore, Singapore, isehb@nus.edu.sg, Ahmad Reza Pourghaderi

We study the sequencing problem of heterogeneous punctual patients with equally spaced appointment times to minimize the expected waiting time of patients. We discuss the widely accepted conjecture that sequencing patients with smaller service time variance first is optimal. The issue of unpunctuality is also discussed. Some important insights are drawn which could be applied for the break time scheduling problem as well.

2 - Single Machine Scheduling with Job-dependent Convex Cost and Arbitrary Precedence Constraints

Rodrigo Carrasco, Assistant Professor, Universidad Adolfo Ibañez, Diagonal Las Torres 2640, of. 532C, Peñalolén, Santiago, RM, 7941169, Chile, rax@uai.cl, Garud Iyengar, Cliff Stein

In this work we combine resource augmentation and alpha-point scheduling techniques to compute approximate solutions for a general family of scheduling problems: each job has a convex non-decreasing cost function and the goal is to compute a schedule that minimizes the total cost subject to precedence constraints. We show that our algorithm is a O(1)-speed 1-approximation algorithm and our numerical experiments show that the speed-scaling ratio needed is actually close to 1.

3 - Appointment Scheduling with Uncertain Patient Arrivals

Mabel C. Chou, National University of Singapore, NUS Business School, 15 Kent Ridge Drive, Singapore, 119245, Singapore, mabelchou@nus.edu.sg, James Ang, Hui-Chih Hung, Qi Yu

We consider a patient scheduling problem for a single class of patients and seek to determine the optimal scheduled interval between patient's appointment time involving a range of patient punctuality distributions. Our objective is to achieve an acceptable trade-off between average patient waiting time and the average makespan of the doctor. We present an analytical model of the problem and obtain a suitable timing policy which presents a near optimal interval between scheduled appointments.

4 - Scheduling of Simple Linear Deteriorating Jobs to Single Machine with Rate-modifying Activities

Hui-Chih Hung, Assistant Professor, National Chiao Tung University, 1001 University Road, Management Bldg. 2, IEM, Hsin-Chu, 300, Taiwan - ROC, hhc@nctu.edu.tw, Hsi-Mei Hsu, Hsiao-ning Lu

We consider a scheduling problem of non-resumable deteriorating jobs on a single machine with rate-modifying activities (RMAs). Multiple RMAs with setup time can be selected to resume the processing speed of machine. The objective is to minimize makespan. We reduce the problem with k-RMAs to a k-way partitioning problem, which is shown to be NP-hard. Bounds on the number of RMAs are examined and a fast heuristic is proposed. Numerical studies are implemented to verify the performances.

■ MB38

Level 2 - Room 213B

New Applications of Multi-Criteria Decision Analysis

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Luiz Autran Gomes, Professor, Ibmec/RJ, Av. Presidente Wilson, 118, Room 1110, Rio de Janeiro, RJ, 20030020, Brazil, autran@ibmecrj.br

1 - Selecting an Academic Collaboration Network using Multi-Criteria Decision Analysis

Owen Hall Jr, Professor, Pepperdine University, 24255 PCH, Malibu, 90263, United States of America, ohall@pepperdine.edu, Joe Hahn

Cloud-based collaboration networks provide a universal platform in which the educational community can converge to share, and exchange ideas to drive innovation in student learning. The purpose of this presentation is to illustrate how multi-criteria decision analysis can be used to help select the appropriate network collaboration system in this complex setting.

2 - Application of AHP and Taguchi Loss Functions in Evaluation of Advanced Manufacturing Technologies

Sharon Ordoobadi, University of Massachusetts, 285 Old Westport Road, Dartmouth, MA, 02747, United States of America, sordoobadi@umassd.edu

Both risks and benefits of implementing a new technology are identified. Since these factors can be objective and subjective a hybrid approach is used in the development of the model. Taguchi loss functions are used to measure performance of each technology candidate with respect to the risks and benefits. Analytic Hierarchy Process (AHP) is used to determine the relative importance of these factors. The composite weighted loss scores are calculated and used for ranking of the technologies.

3 - Solving the Multi-criteria, Multiple Choice Problem

Luiz Autran Gomes, Professor, Ibmec/RJ, Av. Presidente Wilson, 118, Room 1110, Rio de Janeiro, RJ, 20030020, Brazil, autran@ibmecrj.br, Maria A.S. Machado, Luis A.D. Rangel

The multiple choice problem arises when one must select at least two alternatives at the same time. A variation is the multi-criteria, multiple choice problem. It is shown that the bipolar Choquet integral is the most recommended approach for tackling that problem. The paper closes with suggestions for future research.

■ MB39

Auditorium 3

Daniel H. Wagner Prize II

Cluster: Daniel H. Wagner Prize

Invited Session

Chair: Allen Butler, President, Daniel H Wagner Associates, Inc., 2 Eaton Street Suite 500, Hampton, VA, 23669, United States of America, Allen.Butler@va.wagner.com

1 - Wagner Prize

Allen Butler, President, Daniel H Wagner Associates, Inc., 2 Eaton Street Suite 500, Hampton, VA, 23669, United States of America, Allen.Butler@va.wagner.com

The competition for the 2013 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in sux finalists, who submitted papers to the judging committee and who will present their results in three sessions . The winner will be announced and give a reprise in a Tuesday afternoon Keynote session.

2 - Relieving Pressure: Optimizing Water Distribution Pressure Management at Valley of the Moon Water District

Segev Wasserkrug, IBM Research, Haifa University, Mount Carmel, Haifa, 31905, Israel, Segevw@il.ibm.com, Alexey Tsitkin, Alexander Zadorojniy

Valley of the Moon Water District (VOMWD) faced the challenge of managing the pressure of water in their water distribution network, a task which requires simultaneous control of ten valves. We will present how, through application of a novel optimization solution, we enabled VOMWD to significantly improve its pressure management capabilities, resulting in a measured 16% reduction in new leaks/bursts. We will also describe in detail the algorithm and the intricacies of the solution application.

3 - Scheduling the German Basketball League

Stephan Westphal, Professor, Institute for Numerical and Applied Mathematics, University of Goettingen, Goettingen, D-37083, Germany, s.westphal@math.uni-goettingen.de

Each season, the German First Division Basketball League (Beko BBL) is faced with the problem of scheduling the games among their teams. As the classical schedules and models applied so far have caused numerous problems, resulting in postponed games, lost ticket sales and unbalanced standings, we developed a new approach taking all requirements into account. Because of our analysis, the BBL changed their traditional way of scheduling and switched from symmetric to asymmetric schedules.

■ MB40

Auditorium 2

Panel: Overarching OR as a Catalyst for Grand Challenges

Cluster: OR as a Catalyst for Engineering Grand Challenges

Invited Session

Chair: George Nemhauser, Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, United States of America, george.nemhauser@isye.gatech.edu

1 - Panel: Overarching OR as a Catalyst for Grand Challenges

Moderator: Suvrajeet Sen, Professor, University of Southern California, Daniel J. Epstein Department of ISE, Los Angeles, CA, 90089, United States of America, S.sen@USC.edu, Panelists: Cynthia Barnhart, John Birge, Michael Fu, Stefanos Zenios, George Nemhauser

This panel is the second in a series of panels devoted to the role of OR in Engineering Grand Challenges. This panel will go beyond Science and Engineering to cover Social Sciences, and Economics. Panelists will also discuss how the grand challenges pose important opportunities for the OR community to work on overarching problems that cross many boundaries, both theoretical and applied.

■ MB41

Level 1 -101A

Financial Flows and Supply Chain Performance

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Sripad Devalkar, Indian School of Business, Ac3 L1 Room 3114, Gachibowli, Hyderabad, 500032, India, sripad_devalkar@isb.edu

1 - Value of Reverse Factoring in Multi-stage Supply Chains

Hande Cetinay, Technische Universiteit, Eindhoven University of Technology, Eindhoven, Netherlands, h.cetinay@tue.nl, Matthew Reindorp, Jan Fransoo, Fehmi Tanrisever

We present a mathematical model for integration, analysis, and optimization of operational and financial processes within a supply chain. Specifically, we consider commercial transactions of a large corporate with a small supplier. We show how application of reverse factoring influences the operational and financial decisions of these firms. While some empirical work on reverse factoring exists within research literature, our model constitutes the first analytic treatment of the problem.

2 - Orchestrating Procurement Service in Third-Party Logistics

Gangshu Cai, Santa Clara University, OMIS Department, Santa Clara, CA, 95053, United States of America, gcai@scu.edu, Jeannette Song, Xiangfeng Chen

In the innovative procurement service, a 3PL firm can actually escalate the whole supply chain performance by orchestrating both procurement process and shipping for the manufacturer and the retailer. This paper extends the classic newsvendor model to include a manufacturer, a retailer, and a 3PL firm. Our analysis indicates that there exists a Pareto zone where all firms benefit from the procurement service compared with the traditional pure logistics service.

3 - Risk Management, Performance Incentives and Business Insurance in Supply Chains

Juan Serpa, PhD Student, University of British Columbia, Sauder School of Business, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, juan.serpa@sauder.ubc.ca, Harish Krishnan

Performance-Based Contracts (PBCs) play a dual role: they incentivize manufacturers to invest in reliability, and also reduce the buyer's risk exposure. Why then do product buyers also use business insurance to mitigate the risk associated with product failure? We study a context where the contracting parties are subject to limited liability constraints. We show that when limited liability is binding, insurance and PBCs complement each other to optimally balance incentives and risk mitigation.

4 - The Supply Chain Effect of Bankruptcy Reorganization
S. Alex Yang, Assistant Professor, London Business School, Sussex Place, London, NA, United Kingdom, sayang@london.edu, John Birge, Rodney Parker

Focusing on the interaction of supply chain structures and the cost of reorganization, this paper studies the influence of bankruptcy reorganization on both ex ante and ex post operations and performances of the financially distressed firm, its competitor, and its supplier under three supply chain structures.

■ MB42

Level 1 -101B

Economics of Innovation

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Manu Goyal, University of Utah, 1655 E Campus Center Drive, 7235 Sfebb, Salt Lake City, UT, 84112, Manu.Goyal@business.utah.edu

1 - Stage-gate Contracts for Screening Agents for New Product Development
Chunlin Wang, PhD Student, The David Eccles School of Business, University of Utah, 1645 E Campus Center Dr, Salt Lake City, UT, 84112, United States of America, chunlin.wang@business.utah.edu, Glen Schmidt, Krishnan S Anand

A principal wants to outsource an NPD project to an agent. In our setting, the agent has inside information on a project's viability and/or his own competence to execute the project. We study the principal's use of stage-gate contracts as a screening device, and compare the performance of stage-gate contracts with traditional outsourcing contracts.

2 - Price Distributions, Store Sequencing, and Strategic Shopping Behavior
Sreekumar Bhaskaran, Southern Methodist University, Dallas, TX, United States of America, sbhaskar@mail.cox.smu.edu, John Semple

Building on empirical data that suggests buyers purchase groceries from multiple stores, we investigate the optimal sequence of store visits for items whose prices are unknown. We find that the shape of the price distribution plays an influential but sometimes non-intuitive role in lowering expected costs for the buyer. In addition, randomizing prices at the store level improves equilibrium profits for both stores. Effect of loyal consumers on equilibrium prices are also investigated.

3 - R&D Portfolio Valuation
Raul Chao, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, chaor@darden.virginia.edu

We develop an economic model of R&D investment at the portfolio (firm) level and show how the dynamics of the model can be used to infer R&D portfolio strategies based on the market value of the firm. We use secondary data available through COMPUSTAT (cost of goods sold, R&D expenses, and market value of equity) to provide an example of how the data fit our model.

4 - Information Acquisition in Competitive R&D Markets: Market Research Vs. Competitive Intelligence
He Chen, PhD Candidate, University of Maryland College Park, 3330C Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, hechen@rhsmith.umd.edu, Yi Xu, Manu Goyal

Before key R&D decisions, firms often acquire information about important market characteristics. Two most common approaches are market research that collects information through customers, and competitive intelligence that focuses on competitors. We prove that competitive intelligence emerges endogenously, even when information through market research is free and generates higher value.

■ MB43

Level 1 -101C

Retail Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Vidya Mani, Assistant Professor, Pennsylvania State University, University Park, State College, PA, 16802, United States of America, vmani@psu.edu

1 - Preventing Retail Theft: A Test Routine Activity Theory
Christopher Swanton, University of Minnesota, 321 19th Ave. S, Suite 3-150, Minneapolis, MN, 55406, United States of America, swant006@umn.edu, Manus Rungtusanatham, Kevin Linderman

Each year retailers lose billions of dollars to theft perpetrated by both shoppers and employees alike. Through cooperation with a Fortune 100 retailer, we secured a combination of perceptual primary data and objective secondary data describing store-level shrink for over 1,000 retail outlets. We use the tenets of Routine Activity Theory to investigate the efficacy of securitization initiatives on retail theft prevention.

2 - The Impact of Supplier Reliability on Retailer Demand
Nathan Craig, Nicole DeHoratius, Ananth Raman

To set inventory service levels, firms must understand how changes in service level affect customer demand. Using data from a manufacturer of branded apparel, we show increases in service level to be associated with statistically significant increases in retailer orders (i.e., demand, not just sales). Our study not only provides the first empirical evidence of the impact of changes in service level on demand but also illustrates a method for estimating this relationship in practice.

3 - Innovations in Multi-channel Fulfillment in Retail: Empirical Evidence
Ioannis Stamatopoulos, Northwestern University, Kellogg School of Management, Evanston, IL, United States of America, i-stamatopoulos@kellogg.northwestern.edu, Antonio Moreno-Garcia, Santiago Gallino

Retailers are experimenting with novel strategies to integrate the operations of their online and offline channels, including shipping online orders to stores and fulfilling store orders using the online distribution centers. In this study, we use data from a leading national retailer to shed light on the drivers and consequences of this market trend.

4 - Demand Estimation under Substitution and Basket Shopping Effects
Vidya Mani, Assistant Professor, Pennsylvania State University, University Park, State College, PA, 16802, United States of America, vmani@psu.edu, Douglas Thomas, Saurabh Bansal

We use detailed transactional data from a big box retailer to estimate demand when there are substitution and basket shopping effects. We explore the implications of these effects on changing assortments for remodeled stores.

■ MB44

Level 1 -101D

Academic Job Search Panel

Cluster: INFORMS Career Center (formally JPS)

Invited Session

Chair: Neil Geismar, Texas A&M University, College Station, TX, United States of America, ngeismar@mays.tamu.edu

1 - Panel Academic Search
Diwakar Gupta, Professor, University of Minnesota, 130B Mechanical Engineering, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, guptad@me.umn.edu, Sameer Kumar

The panel will discuss the academic interview process and do's and don'ts associated with the job search. In addition to comments by current and former search chairs, time will be provided for questions and answers.

■ MB45

Level 1 -101E

Challenging Decisions in Pharmaceutical Supply Chains

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Hui Zhao, Smeal College of Business, Penn State University, University Park, United States of America, huz10@psu.edu

1 - Perfusion Supply Chain Planning

Dan Bu, University of California, Berkeley, IEOR Dept., Berkeley, CA, 94720-1777, United States of America, danbu@berkeley.edu, Phil Kaminsky

Motivated by some supply chain planning and production control problems faced by a biopharmaceutical firm with which we have worked, we consider production and supply chain planning and control where manufacturing has to be periodically restarted, production rate is random, a subset of production steps are outsourced, and products can expire at any stage of the supply chain, but the "clock" is restarted each time additional steps are completed.

2 - An Analysis of Drug Shortages: Inventory Management and Contract Designs

Justin Jia, Assistant Professor, Purdue University, 509 Krannert Building, West Lafayette, IN, 47907, United States of America, jia16@purdue.edu, Hui Zhao

Drug shortages have recently been a critical problem faced by the pharmaceutical industry. In this study, we investigate the reasons for the shortages, derive optimal inventory policies for drug manufacturers, and design efficient contracts to mitigate the shortages. Our analysis captures key characteristics of drug shortages: frequent manufacturing disruptions, uncertain recovery duration from disruption, limited buyers' patience, low redundancy in capacity, and weak failure-to-supply clauses.

3 - Coordination of the Influenza Vaccine Supply Chain in the Presence of Costly Effort

Xinghao Yan, Ivey Business School, Western University, London, ON, Canada, xyan@ivey.uwo.ca, Greg Zaric

In this paper we develop a model of the influenza vaccination supply chain consisting of a health authority, a vaccine manufacturer, and the general population. We show that in the decentralized case the optimal order quantity is never less than the vaccination demand. Unlike previous research, the optimal fraction vaccinated may be lower than the level that attains herd immunity. We find coordinating contracts under different assumptions about what pieces of information are verifiable.

4 - Inventory Optimization in Clinical Trial Supply Chains

Anh Ninh, Rutgers University, 640 Bartholomew Road, Piscataway, NJ, 08854, United States of America, anhninh@rci.rutgers.edu, Yao Zhao, Adam Fleischhacker

One bottleneck in clinical trials is the slow patient recruitment. Companies typically address this issue by recruiting patients globally, which, however, resulted in significant overages of clinical supplies. In this study, we introduce a class of mathematical models to capture the unique attributes of clinical trial supply chains. We show how to optimally position inventory in such supply chains, and test the effectiveness of the model in a real-world example.

■ MB46

Level 1 -101F

Managing Inventory under Financial Constraints

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Vishal Gaur, Professor of Operations Management, Johnson School, Cornell University, 321 Sage Hall, Ithaca, NY, 14853, United States of America, vg77@cornell.edu

Co-Chair: Yasin Alan, Assistant Professor of Operations Management, Vanderbilt University, Owen School, 401 21st Ave. S., Nashville, TN, 37203, United States of America, Yasin.Alan@owen.vanderbilt.edu

1 - Do High and Low Inventory Turnover Retailers React Differently to Demand Shocks?

Saravanan Kesavan, Assistant Professor, University of North Carolina, Kenan-Flagler Business School, Chapel Hill, NC, United States of America, Saravanan_Kesavan@kenan-flagler.unc.edu, Tarun Kushwaha, Vishal Gaur

In the study, we identify quantity- and price-responsiveness as two mediating mechanisms that distinguish how high- and low-inventory-turnover retailers (HIT and LIT retailers, respectively) can manage demand shocks. In addition, we examine the implications of these mechanisms to excess and shortage of inventories as well as return on assets (ROA)for retail firms.

2 - Inventory Financing and Trade Credit

Sridhar Seshadri, Professor, Indian School of Business, Hyderabad, India, sridhar_seshadri@isb.edu, Qi Wu, Kumar Muthuraman

Suppliers often sell products through credits, and trade credit is one of the common ways to finance inventory for operational firms. As an early payment discount, trade credit can be costly from a cash flow perspective. In this paper, from the operations perspective, we answer the question why trade credit is widely used and benefits the supply chain.

3 - Improving Store Liquidation

Nathan Craig, Doctoral Candidate, Harvard Business School, Wyss House, Soldiers Field Road, Boston, MA, 02163, United States of America, ncraig@hbs.edu, Ananth Raman

Store liquidation is the divestment of retail outlets through an in-store sale of inventory. We introduce the store liquidation problem, discuss its importance to retailers, and give a technique for optimizing key liquidation decisions: markdowns, inventory, and store closings. Through applications, we show that this method improves liquidation outcomes substantially. We identify ways in which current practice differs from the optimal decisions and trace the consequences of these differences.

4 - Operational Investment and Capital Structure under Asset Based Lending

Yasin Alan, Assistant Professor of Operations Management, Vanderbilt University, Owen School, 401 21st Ave. S., Nashville, TN, 37203, United States of America, Yasin.Alan@owen.vanderbilt.edu, Vishal Gaur

We study the implications of asset based lending for operational investment, probability of bankruptcy, and capital structure for a newsvendor firm. Using a single-period game between a business owner and a bank, we show how asset based lending helps the bank mitigate adverse selection under information asymmetry. We also derive the collateral value of inventory, which contrasts with simple rules of thumb used by banks in practice.

■ MB47

Level 1 -101G

Service Operations

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Gad Allon, Professor, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu

1 - Optimal Design of Social Comparisons in Service Cohorts: Setting Reference Points

Guillaume Roels, UCLA, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, guillaume.roels@anderson.ucla.edu, Xuanming Su

In this paper, we study social comparisons in groups such as customer cohorts in services. Social comparisons have been widely used as a "behavioral incentive" e.g., to reduce energy consumption or improve worker productivity. Modeling social comparison as a game between players, we offer prescriptions as to how to set reference points and reference groups to induce desirable equilibrium outcomes.

2 - The Impact of Labor Markets on Managing Operations

Evan Barlow, PhD Candidate, Kellogg School of Management, Northwestern University, 2001 Sheridan Rd., Evanston, IL, 60208, United States of America, e-barlow@kellogg.northwestern.edu, Achal Bassamboo, Gad Allon

Firms in need of specially trained employees often have limited hiring options. If the skills are sufficiently rare in the hiring pool, firms must either pay the expense of training employees or poach trained employees from other firms. We analyze the effect of poaching on operational measures and training decisions in a two-firm newsvendor model. We extend the model to explore the effects on flexible training decisions in a basic newsvendor network environment.

3 - Optimal Allocation of Exclusivity Contracts
Sasa Pekec, Duke University, The Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, pekec@duke.edu, Changrong Deng

We study optimal allocation and pricing of contracts on a network of competing buyers. Buyers have private values for getting the contract and also for getting it exclusively. The monopolist seller limited to offering posted prices should inflate the contract price to capture part of the premium buyers put on exclusivity. Posted prices are not optimal, so we use mechanism design to describe revenue-maximizing procedures and corresponding optimal auctions for exclusivity valuations of interest.

4 - Routing and Staffing to Incentivize Servers in Many-server Systems
Amy Ward, Associate Professor, University of Southern California, Marshall School of Business, Bridge Hall 401H, Los Angeles, CA, 90089, United States of America, amyward@marshall.usc.edu, Ragavendran Gopalakrishnan, Adam Wierman, Sherwin Doroudi

Traditionally, research focusing on the design of scheduling and staffing policies for service systems has modeled servers as having fixed (possibly heterogeneous) service rates. However, service systems are often staffed by people. Then, the rate a server chooses to work is impacted by the system's scheduling and staffing policies. We consider the impact of "strategic servers" on system performance in many-server systems. (There is a companion talk in the Applied Probability cluster.)

■ MB48

Level 1 -101H

Demand Forecasting and Managerial Behavior

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Jordan Tong, Assistant Professor, University of Wisconsin-Madison, 975 University Ave., Madison, WI, 53706, United States of America, jtong@bus.wisc.edu

1 - A Quantal Choice Paradox in a Newsvendor Experiment: The Anchoring Bias Effect
Andrew Davis, Assistant Professor, Cornell University, Ithaca, NY, 14853, United States of America, adavis@cornell.edu, Li Chen

We conduct a simple newsvendor experiment with a two-point demand distribution and find that many of the typical models used to explain newsvendor decisions, include the quantal choice model, cannot explain our data. However, we find that a simple behavioral model where decision makers anchor on demand forecasts fits our data well.

2 - Task Decomposition and Newsvendor Decision Making
Enno Siemsen, Associate Professor, University of Minnesota, 3-150 Carlson School of Management, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, siems017@umn.edu, Yun Shin Lee

We separate order decisions into point forecasts, uncertainty judgments, and service level decisions in a behavioral laboratory experiment. Point forecasts are influenced by the underlying cost parameters. Uncertainty judgments are subject to overconfidence, and service level decisions suffer from a cognitive dissonance bias. In a set of additional experiments, we show that these biases can be mitigated by structuring and framing these judgments and decisions.

3 - Decision Making in Time Series Forecasting
Brent Moritz, Assistant Professor, Pennsylvania State University, 469 Business Building, University Park, PA, 16802, United States of America, bmoritz@psu.edu, Enno Siemsen, Mirko Kremer

Experiments show that individuals exhibit a number of errors in time series forecasting. This includes acting on perceived trends, even when none exist. We investigate how this is impacted by a number of factors, including differences in the time series.

4 - Intuitive Demand Forecasting: Cognitive Simulation and Naive Statistics
Jordan Tong, Assistant Professor, University of Wisconsin-Madison, 975 University Ave., Madison, WI, 53706, United States of America, jtong@bus.wisc.edu, Daniel Feiler

We present an analytical model capturing the psychological underpinnings of single-period demand forecasting. The model assumes individuals cognitively simulate a small sample of possible outcomes and then naively treat it as representative of the true demand distribution. We derive several biases from the model, which we validate experimentally. Finally, we apply the model to study aggregation techniques, using forecast dispersion to predict group confidence, and behavioral newsvendor costs.

■ MB49

Level 1 -101I

Mixed-Integer Second-Order Cone Programming: A Survey

Cluster: Tutorials

Invited Session

Chair: Hande Benson, Associate Professor, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, benson@drexel.edu

1 - Mixed-Integer Second-Order Cone Programming: A Survey
Hande Benson, Associate Professor, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, benson@drexel.edu, Umit Saglam

In this tutorial, we present a survey of the literature on applications of and algorithms for mixed-integer second-order cone programming problems (MISOCPs). Applications include options pricing, portfolio optimization, network design and operations, and statistics, with some examples arising from the use of MISOCPs as relaxations or reformulations of MINLPs. The solution algorithms combine existing solution methods for SOCPs with extensions of MILP or MINLP methods.

■ MB50

Level 1 -101J

Climate Change and OR Applications

Cluster: Climate Change and OR

Invited Session

Chair: Cheng-Marshal Wang, EC, 80 Westpointe Crescent, Ottawa, ON, K2G 5Y9, Canada, Cheng-Marshal.Wang@ec.gc.ca

1 - An Oligopolistic Cellulosic Biofuel Market Model
Yongxi Huang, Clemson University, 314 Lowry Hall, Clemson, SC, 29634, United States of America, yxhuang@clemson.edu, Yihsu Chen

We nested an oligopolistic market model formulated as a complementarity problem in a mixed-integer planning model to assess emerging cellulosic biofuel market. The blenders are allowed to exercise market power when other entities in the market behave competitively. The model was implemented in an illustrative case study of California. We report preliminary results in this talk.

2 - Integrating Ecosystems Values into Policy Decisions
Chiew Chong, Senior Enconomist, Environment Canada, 10 Wellington Street, 25th Floor, Gatineau, QC, K1A 0H3, Canada, chiew.chong@ec.gc.ca

This paper outlines waterfowl values to hunters in America supported by ecosystems in northern Canada. It analyzes how probabilities are used in estimating benefits from mining, and trade-offs of ecosystems values, and its support to climate change and policy research. It reveals how geo-referenced values will promote mining development and conservation of species identified as at risks. Therefore, it recommends integrating ecosystems values into policy decisions in the future.

3 - Transportation Fuel Portfolio Design under GHG Emission Regulations
Yuche Chen, University of California, Davis, One Shields Avenue, Davis, CA, 95616, United States of America, ychchen@ucdavis.edu, Yueyue Fan, Sonia Yeh

In this talk, we will present a bi-level optimization model to simulate the behavior of fuel manufactures and blenders under certain emission regulations in a carbon credit trading market. A case study in California will be included to test the applicability of the model and to draw policy implications.

4 - The Model Design on Extreme Climate Change in Integrated Assessment Model
Cheng-Marshal Wang, EC, 80 Westpointe Crescent, Ottawa, ON, K2G 5Y9, Canada, Cheng-Marshal.Wang@ec.gc.ca

If we are still forward-looking global warming, why there was 0 Celsius degree with 15cm snow in Minneapolis on April 11 2013 but 29 degree in Charlottesville VA on the same day. Should Canada get benefit on global warming? Is Oilsands the principal offender of global warming? How to explain climate change to public? We have tried to model design on quantifying extreme climate change instead of global temperature in our IAM.

■ MB51

Level 1 -102D

Urban Traffic Modeling under Uncertainty

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Yueyue Fan, Associate Professor, University of California-Davis, One Shield Ave., Davis, CA, United States of America, yyfan@ucdavis.edu

1 - Stochastic Traffic Assignment with Price-sensitive Demand: Do Methods Matter?

Harry van der Weijde, Vrije Universiteit Amsterdam, De Boelelaan 1105, Amsterdam, 1081HV, Netherlands, h.vander.weijde@vu.nl, Vincent van den Berg, Erik Verhoef

We compare three classes of stochastic user equilibrium traffic assignment models (multinomial probit, nested logit, and generalized nested logit), using a small transport network. After calibrating all models to the same traffic flows, we use them to evaluate several policy decisions, such as second-best pricing, the construction of new links, and capacity expansion. We then investigate how the optimal policies, and their performance, depend on the model choice.

2 - A Spatial Queuing Perspective of the Fundamental Traffic Diagram

Ketan Savla, Assistant Professor, University of Southern California, KAP 254A, 3620 South Vermont Avenue, Los Angeles, CA, 90089-2531, United States of America, ksavla@usc.edu

We consider a spatial queuing system on a semi-infinite line. Jobs arrive at the origin according to a Poisson process, and leave the system after traveling a distance in the positive direction that is sampled independently from an exponential distribution. The time-varying speeds of the jobs model the dynamic speed adjustment behavior of drivers in transportation systems. We study fluid and diffusion limits of this queuing system, and explore connections with the fundamental traffic diagram.

3 - On Activity-based Network Design Problems

Jee Eun (Jamie) Kang, Assistant Professor, Industrial and Systems Engineering, Institute for Sustainable Transportation & Logistics University at Buffalo, The State University of New York, 409 Bell Hall, Buffalo, NY, 14260-2050, United States of America, jeeeunka@buffalo.edu, Will Recker, Joseph Chow

This paper examines network design where OD demand is not known a priori, but is the subject of responses in household or user itinerary choices to infrastructure improvements. The bilevel formulation includes an upper level network design and shortest path problem while the lower level includes a set of disaggregate household itinerary optimization problems, posed as household activity pattern problem (HAPP) (or in the case with location choice, as generalized HAPP) models.

4 - A Traffic Assignment Model for A Ridesharing Transportation Market

Huayu Xu, University of Southern California, 3715 McClintock Avenue, GER 206, Los Angeles, CA, 90089-0193, United States of America, huayuxu@usc.edu, Fernando Ordonez, Maged Dessouky

We propose a traffic assignment model that describes the interactive relationships between ridesharing activities and traffic congestions in a new Transportation Market, which is an open market where both drivers and passengers can negotiate the ridesharing service prices. The computational tests show how ridesharing impacts traffic congestion, how to motivate participation in ridesharing, and how congestion influences ridesharing, including the prices and the number of participants.

■ MB52

Level 1 -102E

Sustainable Urban Freight Systems/City Logistics

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Jose Holguin-Veras, William H. Hart Professor, Rensselaer Polytechnic Institute, 110 8th St., Troy, NY, 12180, United States of America, jhv@rpi.edu

1 - Off-hour Deliveries: Theory and Implementation

Jose Holguin-Veras, William H. Hart Professor, Rensselaer Polytechnic Institute, 110 8th St., Troy, NY, 12180, United States of America, jhv@rpi.edu

The presentation discusses the economic foundations of off-hour delivery programs. This is accomplished by modeling the behavior of receivers in response to financial incentives, and the ensuing behavior of the carrier in response to both pricing and the receiver decisions concerning off-hour deliveries.

2 - Development of Urban Freight Consolidation Centers: Analysis with Experimental Economics

Cara Wang, Assistant Professor, Rensselaer Polytechnic Institute, 110 8th Street, Troy, 12180, United States of America, wangx18@rpi.edu, Yiwei Zhou

This paper investigates the freight consolidation center development problem with experimental economics. Profit functions are defined for involved stakeholders, and based on those profit functions, four players—representing carriers, operators, government and residents—bid on rent, financial incentives and wages in order to maximize their own profits. Eight scenarios are analyzed and compared to determine potential influential factors and appropriate conditions for FCC decision-making.

3 - Strategies to Improve Urban Freight Systems

Johanna Amaya, Graduate Research Assistant, Rensselaer Polytechnic Institute, 110 Eighth Street, JEC 4037, Troy, NY, 12180, United States of America, amayaj@rpi.edu, Jose Holguin-Veras, Cara Wang, Miguel Jaller, Ivan Sanchez-Diaz, Carlos Gonzalez-Calderon, Jeff Wojtowicz, Michael Browne, Suzann Rhodes, Stacey Hodge

This paper discusses National Cooperative Freight Research Program project #38 which provides practitioners with strategies to improve efficiency in urban freight systems. Public sector strategies were identified and classified into eight groups: Infrastructure Management; Parking/Loading Areas Management; Vehicle-Related Strategies; Traffic Management; Pricing, Incentives and Taxation; Logistical Management; Freight Demand/Land Use Management; and Governance. The role of OR will be discussed.

■ MB53

Level 1 -102F

Freight Transportation Logistics

Sponsor: Transportation Science & Logistics/Facility Logistics

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, Madison, WI, United States of America, ananth@engr.wisc.edu

1 - Crew Planning under Train Schedule Uncertainty

Xiaoyan Si, University of Texas at Austin, 1 University Station, Austin, TX, 78712, United States of America, june_si@utexas.edu, Anant Balakrishnan

We propose a model and methods for crew repositioning in U. S. freight railroads while explicitly considering the uncertainties in train arrival and departure times. The model minimize the total expected cost for deadheading, holding crew members at the away station, and delaying trains due to crew shortage. We compare the operational performance of the best policy and several intuitive rules to generate insights to guide crew planning policies when train schedules are uncertain.

2 - Global Thermal Coal Flow Optimization using a Network Construct

Ashley Arigoni, PhD Student, Colorado School of Mines, 1500 Illinois Street, Golden, CO, 80401, United States of America, aarigoni@mymail.mines.edu, Cameron Turner, Alexandra Newman

Thermal coal is one of the most important global energy sources; it is widely available, inexpensive, and provides dependable power. In the past decade, the thermal coal shipping industry has become vital as coal has undergone a commodization process to accommodate growing demand from new industry players. This presentation examines the thermal coal shipping industry via a network construct, with the goal of gleaning insight into areas for improvement of the current shipping industry.

3 - Bulk Tank Allocation to Improve Distribution Planning for the Industrial Gas Industry

Leily Farrokhvar, Doctoral Student, Virginia Tech, Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, leily@vt.edu, Kimberly Ellis

An important strategic level decision in the industrial gas industry involves the allocation of bulk gas tanks to customer sites. The bulk tank allocation problem determines the preferred size of bulk tanks to assign to customer sites in order to minimize tank investment costs and gas distribution costs. The problem is modeled as a mixed-integer program and then solved using a decomposition approach. The approach is evaluated using data from an international industrial gas distributer.

■ MB54

Level 1 -103A

Market-based Instruments for Congestion Mitigation: II

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Siriphong Lawphongpanich, University of Florida, Industrial and Systems Engineering, 303 Weil Hall, Gainesville, FL, 32611, United States of America, lawphong@ise.ufl.edu

1 - Tradable Credit Schemes on Networks with Mixed Equilibrium Behaviors

Fang He, University of Florida, 511 Weil Hall, Gainesville, FL, 32611, United States of America, jayhe@ufl.edu, Yafeng Yin, Nima Shirmohammadi, Yu Nie

This research analyzes and designs tradable credit schemes on networks with two types of players, namely, Cournot-Nash (CN) players and Wardrop-equilibrium (WE) players. We first show that there are nonnegative anonymous credit schemes that yield system optimum, when transaction costs are not considered. We then analyze how transaction costs would affect the trading and route-choice behaviors of both CN and WE players, and formulated the equilibrium conditions into a variational inequality.

2 - Optimal Occupancy-driven Parking Pricing under Demand Uncertainties and Traveler Heterogeneity

Sean Qian, Carnegie Mellon University, Pittsburgh, PA, United States of America, seanqian@cmu.edu, Ram Rajagopal

A novel parking pricing strategy dependent on real-time sensing is proposed to manage the parking demand. Parking pricing and information provision jointly serve as a dynamic stabilized controller to minimize the total travel time (TTT) of the system. Parking prices are adjusted in real time according to the real-time occupancy collected by parking sensors.

3 - A Tradable Credit Scheme for Managing Morning Commute

Nima Shirmohammadi, University of Florida, 365 Weil Hall, Gainesville, FL, 32611, United States of America, nimashir@gmail.com, Yafeng Yin, Yu Nie

In this talk, we design and analyze a tradable credit scheme for managing bottleneck congestion in the morning commute. In the scheme, a traffic management authority allocates mobility credits to employers or firms in a central business district, and charges a certain number of credits for passing through a bottleneck between residential areas and the district. The employers or firms can distribute the allocated credits among their employees or trade them with other firms at a credit market.

4 - Design of Multi-period Credit based Pricing

Mohammad Miralinaghi, Research Assistant, Purdue University, 2156 Tortuga ln, West Lafayette, IN, 47906, United States of America, smiralin@purdue.edu, Srinivas Peeta

In this study, we assume that a congestion management authority allocates credits to travelers in multiple periods and specifies a deadline for their validity while enabling transfer to the next period free of charge. Also, we investigate the possibility of an alternative design to provide flexibility for the authority to control the market price of the credits.

■ MB55

Level 1 -103B

Hazmat Transport

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Changhyun Kwon, Assistant Professor, University at Buffalo, 318 Bell Hall, University at Buffalo, Buffalo, NY, 14260, United States of America, chkwon@buffalo.edu

1 - Hazardous Material Risk Consequence Evaluation in Train Accidents with Multiple-Tank-Car Releases

Jesus Aguilar Serrano, Graduate Research Assistant, University of Illinois at Urbana-Champaign, 205 N. Mathews Ave., Urbana, IL, 61801, United States of America, glrsrrn2@illinois.edu, Rapik Saat

Consequence estimation is important for evaluating the risk associated with hazardous material transportation. An exposure model is being developed to consider the variation in volume released in train accidents with multiple-tank-car releases.

2 - Estimating the Quantity of Hazardous Material Release from Railroad Tank Cars Involved in Accident

Xiaonan Zhou, University of Illinois at Urbana-Champaign, 205 North Mathews Avenue, Urbana, IL, 61801, United States of America, xzhou27@illinois.edu, Rapik Saat

This study describes a statistical model to estimate the quantity of release in a train accident from a railroad tank car as a function of its design characteristics and accident environments.

3 - A Minimum Risk Equitable Hazardous Materials Flow Model

Ashrafur Rahman, University of Connecticut, 261 Glenbrook Road, Unit 3037, Storrs, CT, 06269, United States of America, arahman@engr.uconn.edu, Nicholas Lownes

We formulate a hazardous materials flow model to minimize the risk over the entire network for multiple origin-destinations. A new approach was used to define link risk using a decay function, travel time, traffic volume, and population. To consider risk equity, we include a risk threshold to limit the risk on each link.

4 - Evaluation of Events Involving a Natural Disaster and Hazardous Materials in the OR/MS Field

Chelsea Greene, Research Assistant, University at Buffalo, Industrial and Systems Engineering, 339A Bell Hall, Amherst, NY, 14260, United States of America, cgreene3@buffalo.edu, Changhyun Kwon, Rajan Batta

In the past few years there has been various events that involved both a natural disaster and man-made hazardous materials. With the continuously rising population and reliance on hazmat goods the probability of these events and their prospective environmental, socio-economic and human-health consequences are increasing. This study identifies relevant issues, future research directions and provides a starting point for researchers to address this growing concern in the OR/MS field.

■ MB56

Level 1 -103C

Interpretable Machine Learning

Sponsor: Data Mining

Sponsored Session

Chair: Berk Ustun, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, ustunb@mit.edu

1 - Supersparse Linear Integer Models for Predictive Scoring Systems

Berk Ustun, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, ustunb@mit.edu, Stefano Traca, Cynthia Rudin

Supersparse Linear Integer Models (SLIM) are highly interpretable classification models that only require users to add, subtract and multiply a few meaningful numbers in order to generate a prediction. In this work, we show how to create SLIM scoring systems using mixed-integer programming, and present experimental results to show that these scoring systems are both accurate and sparse in comparison to state-of-the-art classification models.

2 - Applications of Supersparse Linear Integer Models

Stefano Traca, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, stet@mit.edu, Cynthia Rudin, Berk Ustun

Supersparse Linear Integer Models (SLIM) are highly interpretable classification models that only require users to add, subtract and multiply a few meaningful numbers in order to generate a prediction. In this work, we present a collection of interpretable prediction models that are produced using SLIM. Examples include models that can be used to assess the risk of medical outcomes in hospitals, as well as models to predict the incidence of violent crimes for law enforcement.

3 - Monitoring a Dynamic Network

Bahareh Azarnoush, Student, Arizona State University, Tempe, AZ, 85281, United States of America, bazarnou@asu.edu, George Runger, Jennifer Bekki

Networks can naturally model many real world phenomena. Although the static modeling of networks has been the focus of much research, the intrinsic dynamics of real world phenomena is an important aspect and needs further attention. This in turns calls for the need of monitoring the dynamics of networks. This work presents a non-parametric approach to this problem. An example of such network dynamics is presented in the context of communication among students in a learning environment.

4 - An Interpretable Stroke Prediction Model using Rules and Bayesian Analysis

Ben Letham, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, bletham@mit.edu, Cynthia Rudin, Tyler McCormick, David Madigan

We aim to produce predictive models that are not only accurate, but are also interpretable to human experts. We introduce a generative model called the Bayesian List Machine for fitting decision lists, a type of interpretable classifier, to data. We use the model to predict stroke in atrial fibrillation patients, and produce predictive models that are simple enough to be understood by patients yet significantly outperform the medical scoring systems currently in use.

■ MB57

Level 1 -103D

New Frontiers in Optimal Power Flow Computation

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Shmuel Oren, Professor, UC Berkeley, IEOR Dept, Rm 4135 Etcheverry Hall, Berkeley, CA, 94720, United States of America, oren@ieor.berkeley.edu

1 - The Iterative Linear Current Voltage Formulation of the AC Optimal Power Flow Problem and Testing Results

Richard O'Neill, Chief Economic Advisor, FERC, 888 First Street, NE, Washington, DC, 20426, United States of America, richard.oneill@ferc.gov

In the over 50 years since it was first proposed, we have yet to find commercially viable software to solve the AC optimal power flow (ACOPF). The ACOPF is non-convex. The current software is either too slow or fails to find an optimal solution. Consequently, we solve linear approximations. In this presentation, we review the history of attempts to solve the ACOPF including different formulations and algorithms. We present the iterative linear current voltage formulation and computational results on four standard IEEE test problems.

2 - Approaches to Solving the AC Optimal Power Flow and Implications for Future Research

Anya Castillo, PhD Candidate, Johns Hopkins University, 3400 North Charles Street, Ames Hall 313, Baltimore, MD, 21218, United States of America, anya.castillo@gmail.com, Richard O'Neill

Computational advancements are enabling RTOs/ ISOs to adopt more efficient market design. Even 50 years after developing the ACOPF, we still do not have fast and robust approaches to co-optimize real and reactive power, or to determine losses endogenously in the real markets. A 1% improvement in security constrained dispatch saves roughly 1-5 billion USD per year in the US. We present our current work on ACOPF solution techniques and discuss challenges in developing better methods and software.

3 - An AC-Feasible Linear Approximation Approach to Finding the Optimal Power Flow

Paula Lipka, University of California-Berkeley, 1035 Kains Ave., Apt. 1, Albany, CA, 94706, United States of America, plipka@berkeley.edu, Shmuel Oren

Large energy markets use the solution to the optimal power flow (OPF) problem to determine wholesale energy prices and dispatch of generators. We use a linear approximation of the voltage-current alternating current OPF formulation to find an AC-feasible solution. This method finds solutions faster than and yields total power costs close to the nonlinear benchmark. We also explore incorporating transmission switching into this approach to produce AC feasible transmission switching solutions.

4 - Conic Relaxations and Valid Inequalities for the Alternating Current Optimal Power Flow Problem

Chen Chen, PhD Student, University of California, Berkeley, 450 Sutardja Dai Hall #61, Berkeley, CA, 94708, United States of America, chenchen@berkeley.edu, Richard O'Neill, Alper Atamturk, Shmuel Oren

We develop valid inequalities for the AC Optimal Power Flow problem (ACOPF). It is a nonconvex generation dispatch problem that on certain instances can be solved with the Lagrangian dual. This dual can be cast as a Semidefinite Program (SDP) and hence polynomial-time optimization algorithms apply. Our inequalities are used in a cutting plane algorithm to approximate SDP. On IEEE test cases we are able to take a copper-plate model or branch-based relaxation and converge to the dual solution.

■ MB58

Level 1 -103E

Strategic Harvest Planning

Sponsor: Energy, Natural Res & the Environment/ Forestry/Mining

Sponsored Session

Chair: Erin Belval, Colorado State University, Campus Delivery 1472, Fort Collins, CO, 80523, United States of America, mccowene@gmail.com

1 - A Progressive Hedging Approach to Managing Harvesting Operations on Flammable Forest Landscapes

David Martell, University of Toronto, Faculty of Forestry, Toronto, ON, Canada, david.martell@utoronto.ca, Luis Fernando Solari, Jean-Paul Watson, Roger Wets, David Woodruff, Andres Weintraub

We consider the problem of deciding when and where to harvest stands on flammable forest landscapes. Stands that are harvested before they burn provide fibre and also act as firebreaks that reduce the flammability of the forest and the likelihood that the residual stands will burn before they are harvested. We develop a set of fire ignition and spread scenarios and illustrate the use of progressive hedging methods to solve such problems by applying them to a small hypothetical forest landscape.

2 - Forest Road Upgrading and Harvest Planning

Patrik Flisberg, Creative Optimization, 16 Brocker Tay, Tokai, Cape Town, South Africa, pafli@mweb.co.za, Mikael Frisk, Mikael Ronnqvist

We consider the problem to integrate the upgrading of forest roads and harvest planning. The planning horizon is five years and includes several thousand harvest areas. This model becomes very large and various solution approaches is developed and tested. We compare with the traditional decoupled planning approach and show the benefit with the proposed method. The system is tested on case studies from Swedish forest companies.

3 - Trail Network Design at Harvest Areas

Mikael Ronnqvist, Professor, Université Laval, Pavillon Adrien-Pouliot, 1065, avenue de la Médecine, Quebec, QC, Canada, mikael.ronnqvist@gmc.ulaval.ca, Petrus Jonsson, Patrik Flisberg

We develop a decision support tool to construct road network at harvest areas for harvesters and forwarders. The objective is to minimize ground damage and at the same time have efficient operations. We use high quality GIS information on individual trees through laser scanning, soil information, machine characteristics and information on creeks etc. The system is tested on case studies from Swedish forest companies.

■ MB59

Level 1 -103F

Sustainable and Responsible Supply Chain Management

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Jose Cruz, Associate Professor, University of Connecticut, School of Business, Storrs, CT, 06269, United States of America, Jose.Cruz@business.uconn.edu

1 - Corporate Social Responsibility, Investment, and Performance

Trisha Anderson, Assistant Professor, Texas Wesleyan University, 1200 Wesleyan St., Fort Worth, TX, 76105, United States of America, trdanderson@txwes.edu

A company's financial strength (doing good in the market place) is based on the social reputation of the company. We study the level of corporate social responsibility and performance in various investment factors for different industries from 1991-2010. We investigate the organizational level of involvement in each investment factor over time, the relationship between the investment factors, and validate the distribution of the investment factors to be used for modeling.

2 - Ethical Issues in Supply Chain Competition: A Game Theoretical Approach

Brian Lee, Operations and Information Management Dept, School of Business, University of Connecticut, 2100 Hillside Road Unit 1041, Storrs, CT, 06268, United States of America, brian.lee@business.uconn.edu, Jose Cruz

Today businesses are trying to strike a difficult balance between service level and ethical (responsible) operation due to growing competition and short product life-cycles. While focusing on maximizing profit, firms face the risk of boycotts as a result of falling short of the stakeholder's expectation by their partners in labor or environmental issues. This paper studies, under competition, the effects of the firms' decision to disclose or not social information of their suppliers.

3 - The Role of Product Modularity in Reverse Logistics

Thomas Nowak, Teaching and Research Associate, Vienna University of Economics and Business, Nordbergstrafle 15, Vienna, 1090, Austria, thomas.nowak@wu.ac.at, Fuminori Toyasaki, Tina Wakolbinger

Product design issues play a crucial role in determining a product's life-cycle duration, costs and environmental impacts. In this paper, we study how a product's degree of modularity affects consumer valuation, life expectancy, return quantities and resulting manufacturers' profits. We develop an inter-temporal stochastic nonlinear optimization model that reflects a company's product design decision problem. Model insights can assist companies in making design decisions under uncertainties.

■ MB60

Mezzanine - 100A

Theoretical Data Mining I

Sponsor: Data Mining

Sponsored Session

Chair: Youngrok Lee, Iowa State University, Industrial and Manufacturing Engineering, 3004 Black Engineering, Ames, IA, 50011, United States of America, younglee@iastate.edu

1 - Evaluating Weight Estimation Methods in Hybrid Ensembles

Dirk Van den Poel, Professor of Marketing Analytics, Ghent University, Tweekerkenstraat 2, Ghent, 9000, Belgium, dirk.vandenpoel@ugent.be, Michel Ballings, Dauwe Vercamer

We evaluate multiple classifier fusion methods for a hybrid ensemble of the top-performing classifiers. We test 6 classifier fusion methods (Genetic Algorithm, Self-Organizing Migrating Algorithm, Memetic Algorithm with Local Search Chains, Differential Evolution Algorithm, Particle Swarm Optimization and Generalized Simulated Annealing) and 6 base classifiers (Support Vector Machines, Random Forest, Neural Networks, AdaBoost, Kernel Factory, and Logistic Regression) using AUC and 5x2CV.

2 - Data Mining from Imprecisely Categorized Cases in a Medical Surveillance Database

Youngrok Lee, Iowa State University, Industrial and Manufacturing Engineering, 3004 Black Engineering, Ames, IA, 50011, United States of America, younglee@iastate.edu, Sigurdur Olafsson

Medical surveillance data often fail to deliver precise categorization of cases. However, imprecisely categorized cases still carry more specific information than uncategorized ones; and utilizing this while mining the data may hence improve the results. With real-world data from Surveillance, Epidemiology and End Results (SEER) program, we show how fully utilizing such data contributes to population studies of cancer patients. Challenges of using imprecise categorical data are also discussed.

■ MB61

Mezzanine - 100B

Data Mining Applications III

Sponsor: Data Mining

Sponsored Session

Chair: Jong-Seok Lee, Assistant Professor, Department of Systems Management Engineering, Sungkyunkwan University, 2066 Seoburo Jangangu, Suwon, Korea, Republic of, jongseok@skku.edu

1 - Choosing a Good Probability Estimation Method for Classification-based Collaborative Filtering

Jong-Seok Lee, Assistant Professor, Department of Systems Management Engineering, Sungkyunkwan University, 2066 Seoburo Jangangu, Suwon, Korea, Republic of, jongseok@skku.edu, Wook-Yeon Hwang, Jungmin Lee

Classification-based collaborative filtering is a product recommendation scheme, which performs well for the case of utilizing market basket data in the form of binary user-item matrix. Since predicted purchasing probabilities affect quality of recommendations, it is required to use a good probability estimation method. In this research, we propose to employ random forest regression that was shown in our experiments to perform well and be robust to high-dimensionality and cold-starting problem.

2 - Hierarchical Bayesian Networks for Stochastic Freight Truck Demand Estimation

Yinyi Ma, Erasmus University, Burg, Oudlaan 50, Rotterdam, Netherlands, yma@rsm.nl, Kuik Roelof, Henk van Zuylen

Hierarchical Bayesian Networks (HBN) are applied to estimate freight truck demand. The measurements from link flow such as loop detectors and path flow from such as cameras are the evidences to update prior demand. We consider multiplicative errors in the measurements, instead of additive errors. It requires Markov-chain-Monte-Carlo simulation.

■ MB62

Mezzanine - 100C

Data Fusion in Healthcare Applications I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, Atlanta, GA, United States of America, kamran.paynabar@isye.gatech.edu

Co-Chair: Ran Jin, Virginia Tech, Grado Dept of Industrial and Systems, Engineering, 111 Durham Hall, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

1 - Boosted Tree Ensembles for Predicting Postsurgical ICU Mortality

Garrick Aden-Buie, University of South Florida, 4202 E. Fowler Ave., Tampa, FL, 33620, United States of America, gadenbuie@mail.usf.edu, Yun Chen, Gina Romero, Rashad Kayal, Hui Yang

Real-time monitoring of patient conditions in the ICU environment is essential in supporting clinical decisions and ensuring optimal allocation of medical resources. This study focuses on accurately predicting in-hospital ICU patient mortality utilizing functional profile data. We demonstrate that a boosted trees ensemble model is well suited for the diverse data typologies present in ICU data and provides an interpretable and accurate model to aid clinical experts in critical ICU decisions.

2 - Clinical Workload Prediction Model for Patient-centered Medical Homes

Issac Shams, Research Assistant, Wayne State University, 4815 4th Street, Detroit, MI, 48201, United States of America, er7671@wayne.edu, saeede ajorlou, Kai Yang

In current practices of medical homes, a clinical-based prediction frame is recommended because it can help match the portfolio capacity of primary care teams with the actual load generated by a set of patients. In this talk, by extending the hierarchical generalized linear model to include multivariate responses, we present a workload prediction model for care portfolio demands in a Bayesian framework.

3 - A Decision Support System on Surgical Treatments for Rotator Cuff Tears

Weihong Guo, PhD Candidate, University of Michigan, 1205 Beal Avenue, IOE Building, ANN ARBOR, MI, 48105, United States of America, graceguo@umich.edu, Kamran Paynabar, Judy Jin

Treatment of patients with rotator cuff tears usually starts with physical therapy, but some patients may eventually require surgery. Ineffective physical therapy increases the time, cost, and pain for patients while undergoing treatment in addition to continuing pain after the therapy. This research developed a decision support system to help identify the patients who will not respond to physical therapy by effectively analyzing patients' examination data.

4 - Organ Preservation and Viability Evaluation in Transplant

Ran Jin, Virginia Tech, Grado Dept of Industrial and Systems, Engineering, 111 Durham Hall, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Tingting Huang, John Robertson

Organ transplant helps many critically-ill patients regain control of their lives. However, fewer than 20% of patients who need a transplant actually receive one. Many potentially useful organs are discarded because of limited means to evaluate the viability and potential long-term function of organs. In this research, we develop a viability evaluation index based on biopsy image data. We validate the organ viability index based on the study of isolated, perfused pig livers.

■ MB63

Mezzanine - 100D

Advanced Reliability Testing Models and Testing Plans

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Ye Zhang, University of Arizona, 1557 N Santa Rita Ave., Tucson, AZ, 85719, United States of America, yezhang1@email.arizona.edu

1 - Accelerated Destructive Degradation Test: Data Analysis and Test Planning

Yili Hong, Assistant Professor, Virginia Tech, Blacksburg, VA, United States of America, yilihong@vt.edu, Caleb King

Accelerated destructive degradation tests (ADDTs) are often used to obtain material reliability information. The current industrial standard analysis uses a two-step approach. An alternative is the ADDT analysis approach which models degradation path as a function of time and temperature. We investigate the pros and cons of both approaches and use simulations to study the performance of the standard method. Statistically efficient and robust test planning procedures will also be discussed.

2 - Reliability Acceptance Test Based on Accelerated Life Testing

Elsayed A. Elsayed, Professor, Rutgers University, 96 Frelinghuysen Rd., Piscataway, NJ, 08854, United States of America, elsayed@rci.rutgers.edu, Yao Cheng

Traditional design of reliability acceptance test is performed under the product's working condition which requires a large sample size and long test duration. In this paper, we investigate an accelerated life testing reliability acceptance test based on accelerated life testing. We design the reliability acceptance test by utilizing different types of stress loading and types.

3 - Analysis of Destructive Degradation Test for a Product with Random Degradation Initiation Time

Ye Zhang, University of Arizona, 1557 N Santa Rita Ave., Tucson, AZ, 85719, United States of America, yezhang1@email.arizona.edu, Haitao Liao

In this paper, we develop two delayed degradation models based on destructive degradation test data to evaluate the reliability of a product with a random degradation initiation time. Fixed-effects and random-effects gamma processes are considered, respectively. EM algorithm is implemented to calculate the MLE in both models. Monte Carlo approach is used to obtain the confidence intervals.

4 - Comparison of Constant-stress ALT and Step-stress ALT under Time Constraint

David Han, Assistant Professor, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, david.han@utsa.edu

By running an experiment at higher stress levels, accelerated life tests (ALT) quickly yield information on lifetime parameters. In constant-stress ALT, a unit is tested at a fixed stress level while step-stress ALT allows increasing stress levels at pre-fixed time points. In this talk, optimal k-level constant-stress and step stress ALT are compared for exponential distribution under time constraint. The objective is to quantify the advantage of step-stress ALT relative to constant-stress one.

■ MB64

Mezzanine - 100E

Design for High Reliability, Robustness, and Resilience II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Pingfeng Wang, Assistant Professor, Wichita State University, WIchita, KS, United States of America, Pingfeng.Wang@wichita.edu

1 - A New Sequential Sampling Scheme for Reliability-based Design Optimization

Pingfeng Wang, Assistant Professor, Wichita State University, WIchita, KS, United States of America, Pingfeng.Wang@wichita.edu, Zequn Wang

This talk presents a new sequential sampling approach for efficient simulation-based design for reliability. A cumulative confidence level (CCL) is defined to quantify the accuracy of reliability estimation using Kriging models and a new sequential sampling scheme is then developed to sequentially enroll new design samples to update the Kriging models based on the maximum improvement of the defined CCL measure. Multiple case studies are used to show the efficacy of the methodology.

2 - Robust Scheduling on Uniform Parallel Machines to Minimize Total Flow Time

Xiaoqing Xu, PhD Student, School of Management, Xi'an Jiaotong University, PO Box 2268, No.28, Xianning West Road, Xi'an, 710049, China, xxq.107@gmail.com, Wentian Cui, Jun Lin

This paper addresses a uniform parallel machine scheduling problem wherein the job processing times are uncertain but lie in closed intervals. A robust (min-max regret) model is proposed. To solve this NP-hard problem, we first prove that the maximal regret for any schedule can be obtained by solving an assignment problem. We then develop two MILP formulations and a 2-approximation algorithm. Finally, computational experiments are conducted to evaluate the performance of the proposed methods.

■ MB65

Mezzanine - 100F

Social Media and Group Activities

Cluster: Social Media Analysis

Invited Session

Chair: Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, United States of America, lservi@mitre.org

1 - Alert Dissemination through Social Networks in Extreme Events

Xin Ma, Texas A&M University, 3006 ETB, College Station, TX, 77843, United States of America, xma@tamu.edu, Justin Yates

Social networks are playing an increasingly important role in extreme event management. We propose to integrate independent subscription networks with social networks for message/alert dissemination in extreme events. We develop a multi-network, multi-period model to maximize message dissemination and reliability while minimizing message starts and test our model through experimentation.

2 - Statistical Monitoring of Microblog Media Streams

Jeremy D. Ezell, Auburn University, Auburn, AL, United States of America, jde0009@auburn.edu, L. Allison Jones Farmer

Modern statistical methods for detecting true signals for monitored activity in high-velocity social media streams are considered. We survey and assess the applicability of existing statistical surveillance methods and investigate potential refinements and applications using multiple microblog data streams. Challenges and opportunities for research are discussed.

3 - Social Media, Crowdsourced Data and Health Informatics

Maksim Tsvetovat, Founder & CTO, Open Cancer Network, 2230 George C. Marshall Dr, Falls Church, VA, 22043, United States of America, maksim@tsvetovat.org

Social media and crowdsourcing presents an opportunity for researchers and decision makers in the health and medical fields to learn orders of magnitude more about their audiences, about spread and incidence of diseases and about effect of healthcare policies. In this session, we invite presentations that use social media and crowdsourced data to solve real problems in healthcare, disease prevention, public health, epidemiology and health research.

4 - Computational Modeling of Sociopragmatic Language Use in Arabic and English Social Media

Mona Diab, George Washington University, Washington, DC, United States of America, mtdiab@gwu.edu

Social media language is a treasure trove for mining and understanding human interactions. In discussion fora, people naturally form groups and subgroups aligning along points of consensus and contention. In this talk, I will present our work on subgroup modeling and detection in both Arabic and English social media language. This work is the beginning of an interesting exploration into the realm of building computational models of some aspects of the sociopragmatics of human language.

■ MB66

Mezzanine - 100G

Healthcare and Service Management

Sponsor: Information Systems

Sponsored Session

Chair: Emre Demirezen, State University of New York at Binghamton, School of Management, Binghamton, NY, United States of America, edemirezen@mays.tamu.edu

1 - Scheduling Operating Rooms with Uncertain Surgery Times

Emre Demirezen, State University of New York at Binghamton, School of Management, Binghamton, NY, United States of America, edemirezen@mays.tamu.edu, Subodha Kumar, Michael Pinedo, Chelliah Sriskandarajah

We develop an operating room scheduling model that deals with uncertainty in surgery durations and determines the sequence of surgeries and their start times such that the total cost of earliness, tardiness, and overtime is minimized. We assume that as soon as a surgery finishes, the next surgery can be started. This assumption is relevant in some settings, yet our solution also serves as a bound to the problems in settings where a surgery cannot start earlier than its scheduled start time.

2 - A Survey of Research in Product Support

Sal Agnihothri, Professor, School of Management, Binghamton University, SUNY, Binghamton, NY, 13902-6000, United States of America, agni@binghamton.edu

Product support (after-sales support) encompasses all the goods and services supplied by a manufacturer to maximize the trouble-free use of a product/service by the customer. Product support is an increasingly important factor in competition. In this talk we analyze critical issues, review past research, and outline future research opportunities in product support.

3 - An All-or-None Inspection Policy for Inaccurate Data Records

Howard Hao-Chun Chuang, Assistant Professor, National Chengchi University, Dept. of Management Information Systems, No.64, Sec. 2, Zhinan Rd., Wenshan Dist., Taipei, 11605, Taiwan - ROC, hchuang@mis.nccu.edu.tw, Rogelio Oliva

We develop an all-or-none inspection policy to tackle data inaccuracy, which is a pervasive problem in practice. Some qualitative insights about the interaction between inspector fallibility, risk preferences, and optimal inspection decisions are derived from analytics assuming risk-neutrality and simulation under risk-aversion. Also, we propose a Bayesian hierarchical model to make statistical inferences about unobserved inspection errors that are critical to the inspection policy design.

4 - The Design of Feature-limited Evaluation Software

Jyotishka Ray, Student, University of Texas at Dallas, Naveen Jindal School of Management, Richardson, TX, 75083, United States of America, jxr114030@utdallas.edu, Deborah Manica, Syam Menon, Vijay Mookerjee

We focus on a commonly used type of free evaluation software–one where a subset of the features in the software is disabled. Providing too many features may deter the customers in buying the original software whereas providing too less features may not generate an adequate signal to the customers. We model the vendor's problem of designing a feature-limited demo as a non-linear integer program which is NP-complete. Scenario Aggregation algorithm is used to obtain a best feasible optimal solution.

■ MB67

Mezzanine - 100H

Panel Discussion: Teaching Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Candice Huynh, University of California, Irvine, Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, candich@uci.edu

Co-Chair: Robin Keller, Professor, University of California- Irvine, Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, lrkeller@uci.edu

1 - Introduction to Panel Session and Tips for Teaching Decision Analysis Software

Moderator: Candice Huynh, University of California, Irvine, Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, candich@uci.edu, Panelist: Robin Keller

This session will run as a panel discussion. Each panelist will make a short presentation on their perspective on the facets of teaching decision analysis. Then, an open discussion will follow. After introducing the session, I will provide tips on teaching decision analysis software based on experience teaching MBA students.

2 - Quick Decision Analysis for MBAs

Moderator: Robin Keller, Professor, University of California- Irvine, Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, lrkeller@uci.edu

If you only have a few sessions to teach decision analysis to MBAs, what should you do? What are realistic objectives that can be achieved, useful "take aways" for students, the role of experiential learning, and appropriate instructional materials and software?

3 - Rethinking Teaching Decision Analysis

Panelist: Greg Parnell, Consultant, Innovative Decisions Inc., Vienna, VA, United States of America, gparnell@innovativedecisions.com

Two years ago, I wrote the Wiley & Sons' Handbook of Decision Analysis with three colleagues with extensive consulting experience which was published in Mar 2013. As a result of the research and writing, I fundamentally changed my spring Decision Analysis course. I will present my insights and experience with the revised course.

4 - Active Learning in Teaching Decision Analysis

Panelist: Jason Merrick, Professor, Virginia Commonwealth University, Richmond, VA, United States of America, jrmerric@vcu.edu

The DA course at VCU yields interesting projects: * Helping a major bank implement a change in teller operations; * Removing counterfeit currency from circulation; * Deciding how to fund a new educational institute in India; * Determining whether a spouse should return to work after having a baby; * Determining the impact of expedited drug approval; * Deciding whether a son should start Kindergarten or wait a year. We will discuss the role of active learning in a DA course.

5 - Teaching Decision Analysis with the Case Method

Panelist: Casey Lichtendahl, University of Virginia, Darden School of Business, 100 Darden Blvd., P. O. Box 6550, Charlottesville, VA, 22906, United States of America, lichtendahlc@darden.virginia.edu

I will address a question I am frequently asked, How do you teach Decision Analysis, or any quantitative subject, without lecturing in the classroom? I will discuss the power of the "flipped classroom" approach that the Darden School of Business and other case-method schools/teachers have been using for decades.

■ MB68

Mezzanine - 100I

Graphical Models in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Debarun Bhattacharjya, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10598, United States of America, debarunb@us.ibm.com

1 - Managing Risks in Strategic Planning

Jesus Rios, IBM T.J. Watson Research Center, Yorktown Heights, NY, United States of America, jriosal@us.ibm.com

A basic approach to strategic planning is to make numerical assumptions about the future and compute based on them and a business model a set of performance metrics. To deal with risk and uncertainties, a full probabilistic risk analysis can be used. We present a practical approach at measuring and managing risks in the context of strategic planning, addressing both the number of probabilistic judgments required from experts and the computations typically needed to run the analysis.

2 - The Value of Sample Information for Discrete Uncertain Variables

Ahren Lacy, Stanford University, Huang Engineering Center, 475 Via Ortega, Stanford, CA, 94305-4121, United States of America, ahrenlacy@stanford.edu, Ross Shachter

A decision maker has the opportunity to purchase multiple samples of discrete uncertain variables prior to an upcoming decision. We derive an approximate analytical expression for the value of the sample information as a function of the number of samples of each variable and their costs. We maintain the structure of a general decision problem with finite alternatives. Our work extends the classic results of Raiffa and Schlaifer (1961) using a Gaussian approximation to the sample information.

3 - Efficiently Appraising Decision Situations

Debarun Bhattacharjya, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10598, United States of America, debarunb@us.ibm.com, Ross Shachter

The appraisal stage is crucial in decision analysis, helping the decision maker understand the benefits of obtaining greater parameter precision and in exploring opportunities for improving their decision situation. Being able to do so efficiently is particularly crucial for large real-world problems. In this talk, I will describe the myriad capabilities of decision circuits in this regard, using several illustrative examples.

■ MB69

Mezzanine - 100J

Decision Analysis II: Optimizing Strategic Decisions

Contributed Session

Chair: Nadine Oeser, PhD Candidate, London School of Economics and Political Science, Rheinstrasse 63, Berlin, 12159, Germany, N.Oeser@lse.ac.uk

1 - Optimal Nesting Structures for Nested Logit Discrete Choice Analysis

Ashley Mc Minn, Queens University Belfast, David Bates Building, 7 College Park, Belfast, BT7 1NN, United Kingdom, amcminn02@qub.ac.uk, Martin Spollen, Adele Marshall, Karen Cairns

This paper presents a new autonomic approach for developing a nested logit model where no predefined structure is required. The technique proposes a solution that optimises the nesting structure using the empirical dataset, rather than it be imposed a priori by the researcher. The method is applied to a case study which considers student choice of college in Northern Ireland.

2 - Optimal Contracting in Networks under Asymmetric Information

Ali Kakhbod, University of Pennsylvania, L465 Levine Hall 3330 Walnut Street, Philadelphia, PA, 19104, United States of America, akakhbod@seas.upenn.edu, Ali Jadbabaie, Alireza Tahbaz-Salehi

We study the optimal contracting strategy of a firm that sells a divisible good to a group of consumers. The consumers are embedded in a network which captures the positive externality that they receive from their neighbors' consumption. The extent of this externality is the private information of the consumers. We explicitly characterize the firm's optimal contract as a function of the underlying network structure.

3 - Modeling Latent Preferences when Choice Outcomes Reflect Limited Availability of Some Alternatives

Martin Spollen, Queens University Belfast, David Bates Building, Belfast, BT7 1NN, United Kingdom, mspollen01@qub.ac.uk

The paper presents a solution to the capacitated discrete choice problem. Using empirical data on ex-post outcomes, a simulation-based strategy is used to recover the unbiased parameters of a choice model that reflects latent preferences in the population studied. An application to free school choice in Northern Ireland is presented. The results have relevance to other situations where price may not clear the market efficiently.

4 - Teaching and Evaluating Decision-Making Competence

Nadine Oeser, PhD Candidate, London School of Economics and Political Science, Rheinstrasse 63, Berlin, 12159, Germany, N.Oeser@lse.ac.uk, Carl Spetzler, Chris Spetzler, Ali Abbas

On the path to a successful career and happy personal life, young people face many complex decisions that significantly influence their lives. Improving their decision-making competence (DMC) can have a positive impact with wider benefits across society. Research on how to adequately measure DMC can help to create a better understanding of the different aspects of DMC, and therefore, guide the teaching of DMC.

5 - Probabilistic Sensitivity Analysis with Fixed Probabilities

Terry Reilly, Associate Professor, Babson College, Division of Mathematics, Babson Park, MA, 02457, United States of America, reilly@babson.edu

A straightforward methodology is presented to carry out a probabilistic sensitivity analysis on continuous uncertainties. We show that by varying the fractile values instead of the probabilities, we can measure the influence of the tails of the distributions, either individually or jointly, and we can investigate the influence of the assessments.

■ MB70

Mezzanine -101A

Joint Session AAS/TSL: Service Level Expectation Setting for Air Traffic Management

Sponsor: Aviation Applications & Transportation Science & Logistics

Sponsored Session

Chair: Michael Ball, Professor, University of Maryland, Robert H Smith School of Business, College Park, MD, 20742, United States of America, mball@rhsmith.umd.edu

1 - A New Mechanism for Service Level Expectation Setting in Air Traffic Management

Michael Ball, Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, mball@rhsmith.umd.edu

A research team with participation from MIT, UC Berkeley and the University of Maryland has developed a new mechanism for generating a airline-consensus strategic plan for guiding air traffic management on a given day of operations. The output takes the form of a multi-dimensional service level expectation vector. The underlying models and analysis employ voting theory, performance estimation, integer and linear programming and game theory.

2 - Underlying Models for Service Expectation Setting Mechanism in Air Traffic Flow Management

Prem Swaroop, PhD Candidate, University of Maryland, RH Smith School of Business, College Park, MD, 20742, United States of America, pswaroop@rhsmith.umd.edu, Michael Ball

The shared and common threat of inclement weather forces the competing airlines to seek consensus regarding their ATM service level expectations. We present a mechanism that effectively finds consensus-based design solution that has many desirable properties - including high accuracy, confidentiality and strategy-resistance. We present the the optimization models and statistical estimation methods underlying the mechanism, and show its effectiveness through a large simulation run.

3 - Benefit Assessment for Setting Consensus Service Level Expectations in the National Airspace System

Chiwei Yan, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 1-245, Cambridge, MA, 02139, United States of America, chiwei@mit.edu, Cynthia Barnhart, Vikrant Vaze

We design a consensus-based mechanism to inform the design of traffic management initiatives. Given various Federal Aviation Administration strategies implemented to manage congestion, we develop an integrated recovery model and algorithm to capture airline preferences with respect to inherent operational trade-offs (such as capacity, predictability, etc.). Using case studies derived from real-world data, we evaluate our mechanism and quantify the potential benefits to multiple stakeholders.

4 - A Retrospective Evaluation of Ground Delay Program

Yi Liu, University of California, Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com, Robert Hoffman, Mark Hansen

This study establishes five performance criteria for GDP evaluation and specifies performance metrics for each performance goal. Pilot bench-marking analysis is conducted for SFO and EWR for 2006 and 2011. In the on-going research, performance frontier is being constructed for each cluster of GDP days defined by demand and capacity levels.

■ MB71

Mezzanine -101B

Aviation Applications

Sponsor: Aviation Applications

Sponsored Session

Chair: Jorne Van den Bergh, HUBrussel, Warmoesberg 26, Brussels, Belgium, Jorne.VandenBergh@hubrussel.be

1 - A New Linear Integer Formulation for the Ground Delay Program with Misconnections

Jens Brunner, Professor, Universität Augsburg, Universitätsstr. 16, Augsburg, Germany, Jens.Brunner@wiwi.uni-augsburg.de

In the paper addresses the rescheduling problem by an airline when a ground delay program (GDP) is issued. The objective is to minimize delay measures and cost for crew and passenger misconnections subject to several restrictions. A new linear integer model is presented. Using a real-world example we show the efficiency of the modeling approach. High quality solutions can be found quickly and management can use the model to evaluate the trade-off between delays and misconnections.

2 - A Two-stage MIP Approach to Optimize the Skill Mix and Training Schedules for Aircraft Maintenance

Philippe De Bruecker, KU Leuven, Naamsestraat 69, Leuven, Belgium, philippe.debruecker@kuleuven.be, Jorne Van den Bergh, Jeroen Beliën, Erik Demeulemeester

We present a two-stage mixed integer programming approach for optimizing the skill mix and training schedules at an aircraft maintenance company. The first step is to make a trade-off between cheaper rosters that require higher skilled workers and the training costs to obtain this higher skilled workforce. The second step is to design an optimal training schedule to obtain the optimal skill mix with minimal costs. We illustrate our models with a computational experiment based on real life data.

3 - A Rolling Horizon Approach for Aircraft Line Maintenance Scheduling

Jorne Van den Bergh, HUBrussel, Warmoesberg 26, Brussels, Belgium, Jorne.VandenBergh@hubrussel.be, Erik Demeulemeester, Liesje De Boeck, Philippe De Bruecker, Jeroen Beliîn

We present a rolling horizon framework for an aircraft line maintenance scheduling problem. The first step consists of the creation of personnel rosters, considering the cyclic workload. In the second step, a robust maintenance base schedule is developed by taking into account the delay distributions. The third step consists of the rolling horizon algorithm where the flight delays are simulated and the maintenance base schedule is adjusted.

■ MB72

Mezzanine-101C

Stochastic Control in Mathematical Finance

Cluster: Risk Management

Invited Session

Chair: Gechun Liang, King's College London, Department of Mathematics, Strand, London, WC2R 2LS, United Kingdom, gechun.liang@oxford-man.ox.ac.uk

1 - Asymptotics for Optimal Investment and Consumption with Small Capital Gain Tax and Interest Rate

Min Dai, Associate Professor, National University of Singapore, Department of Mathematics, Singapore, Singapore, matdm@nus.edu.sg, Xinfu Chen

We consider continuous-time optimal investment and consumption decision of a constant relative risk aversion investor who faces capital gain tax. We present an asymptotic expansion of the optimal strategy with small interest/tax rate.

2 - Robust Optimal Stopping under Volatility Uncertainty

Song Yao, University of Pittsburgh, 404 Thackeray Hall, Pittsburgh, PA, 15260, United States of America, songyao@pitt.edu

We study a robust optimal stopping problem with respect to mutually singular probabilities. This can be interpreted as a zero-sum controller-stopper game in which the stopper is trying to maximize its pay-off while an adverse player wants to minimize this payoff by choosing an evaluation criteria. We show that the first time when the reward process meets its the upper Snell envelope is the optimal stopping time for the robust optimal stopping problem.

3 - Stochastic Control Representation for Penalty Method of Optimal Stopping Problems

Gechun Liang, King's College London, Department of Mathematics, Strand, London, WC2R 2LS, United Kingdom, gechun.liang@oxford-man.ox.ac.uk

We show that both reflected backward stochastic differential equation and its associated penalized equation admit both optimal stopping representation and optimal control representation. We also show that both multidimensional reflected BSDE and its associated penalized BSDE admit optimal switching representation. The corresponding optimal stopping (switching) problems for penalized BSDE have the feature that only stopping at exogenous Poisson arrival times is allowed.

Monday, 12:30pm - 2:30pm

■ Interactive Session

Exhibit Hall D

Monday Interactive Session

Cluster: Interactive Sessions

Invited Session

Chair: Stephanie Snyder, Operations Research Analyst, USDA Forest Service, 1992 Folwell Avenue, St. Paul, MN, 55108, United States of America, stephaniesnyder@fs.fed.us

1 - Optimization of the Traveling Plan for Safety-Checking of Household Gas Appliances

Yohei Nakai, Tokyo Gas Co.,LTD., 5-20, Kaigan 1-Chome, Minato-Ku, Tokyo, Japan, y.nakai@tokyo-gas.co.jp, Kanako Nakayama

It is duty for gas companies to safety-check the gas appliances of end-users in every three years. The traveling plan has been inefficient gradually due to changing customer numbers and it results in the additional costs for keeping the legal visit intervals, and therefore we developed the optimization model for rescheduling the plan. The expected traveling time and additional costs are dramatically reduced by the optimization.

2 - New Tools for Analytics and Simulation: Meeting the Challenges of "Big Data

Adam McElhinney, Head of Business Analytics, Enova Financial, 2940 N. Sheffield, Unit 1S, Chicago, Il, 60657, United States of America, adam.m.mcelhinney@gmail.com

There has been an explosion in the availability of software for OR professionals. Much of this software is designed to handle the challenges of "Big Data". Further, much of this software is open source and completely different. This has left many OR professionals confused as to which software would be applicable for specific problems. This will address these issues and provide the viewer with a tool that they can use to help select the best software for their specific future projects.

3 - Sales Effectiveness-customer Churn Analysis

Setareh Mardan, Senior Scientist, PROS, 3100 Main Street, Suite # 900, Houtson, TX, 77002, United States of America, smardan@prospricing.com

A medical equipment distributor with hundreds of thousands products and customers is the subject of this study. The company had challenges proactively identifying the customers at risk of churn. We provided the company with an innovative methodology to identify these customers. Our approach combines two criteria: the customer's peer's churn risk and the customer's buying pattern risk. A return of investment analysis showed 3-8M dollars (1-3% of annual revenue) saving.

4 - Impact of Climate Change on Electricity Systems and Markets

Shankar Chandramowli, Doctoral Candidate/Research Assisstant, Rutgers University -CEEEP, 33 Livingston Avenue, Rm:254, New Brunswick, NJ, 08901, United States of America, shankarc@eden.rutgers.edu, Frank Felder

This research examines the potential impact using economic modeling and scenario analysis techniques. We have constructed a regional-scale assessment model for the electricity sector in New Jersey. Using climate data projections from a general circulation model (GCM), we have modeled a set of scenarios to study the nature of demand and supply in New Jersey's electricity sector 40-50 years into the future.

5 - An Automated Fraud Auditing System with Health Insurance Records

Fletcher Lu, Assistant Professor, University of Ontario Institute of Technology, Faculty of Business and IT, 2000 Simcoe Street North, Oshawa, ON, L1H7K4, Canada, fletcher.lu@uoit.ca

We present the algorithm, software implementation and test results of an automated auditor support system to detect fraud. It models health insurance records as a network of states following the Markov property related through their common attributes building cases of fraud by extracting information from databases of multiple differing formats.

6 - Approximating Disaster Recovery with Construction Activity Divergences

Henry Lester, University of Alabama, Box 870205, Tuscaloosa, AL, 35487-0205, United States of America, leste019@crimson.ua.edu

This research presents a change-point approach to estimate the disaster recovery period. Specifically, the research considers Fisher type price adjusted spatial new residential construction and equates mean changes with accompanying declared disasters to ascertain any relationships. The methodology examines construction variability to determine built environment rapidity by measuring to duration between sequential mean changes to provide a temporal metric for operative disaster planning.

7 - Analysis of Private Sector Data in Utilization with Disaster Relief
Matthew Brondum, University at Buffalo, 328 Bell Hall, Buffalo, NY, 14228, United States of America, mcbrondu@buffalo.edu, Thomas Darlington

FEMA currently makes use of WaffleHouse statuses in southeastern United States to gauge the condition of a region in order to efficiently administer disaster relief. The "WaffleHouse Index" can not be applied to regions outside of the southeastern United States due to the scarcity of WaffleHouse locations elsewhere. In this research we explore whether available private sector data following Hurricane Sandy can be used to compare different businesses' abilities.

8 - PDE and PDDE Applied to Gas and HydroThermal Planning
Andre Marcato, Associate Professor, Federal University of Juiz de Fora, Faculdade de Engenharia - PPEE, Sala 206, Juiz de Fora, MG, 36037-720, Brazil, andre.marcato@ufjf.edu.br, Tales Ramos, Dejair Domingues, Anderson Iung, Ivo Silva Junior, Paulo Alves

This paper presents a comparison between two methodologies to include the constraints related to natural gas availability in the hydrothermal systems operation planning problem. So, it will be evaluated (a) a decoupled methodology (b) a coupled methodology, where the optimization procedure realizes the hydrothermal dispatch considering the gas availability constraints.

9 - Impact of Different Carbon Regulatory Policies in Biofuel Supply Chain Network under Uncertainty
Mohammad Marufuzzaman, Research Assistant, Mississippi State University, PO Box 9542, Industrial & Systems Engineering, Starkville, MS, 39759, United States of America, maruf237@gmail.com, Sandra Eksioglu

This study presents mathematical models that capture the impact of different carbon emission-related policies on the design of the biofuel supply chain. A two stage stochastic programming model is proposed for this problem. The model is solved using a modified L-shaped algorithm.

10 - A Genetic Algorithm for Solving the Stochastic Dynamic Facility Layout Problem
Adriana Garcia, Student, Pontificia Universidad Javeriana, Carrera 21 #104-52, Bogata, Colombia, a-garcial@javeriana.edu.co, Clara Novoa, Eliana Maria Gonzalez

We describe the implementation of a genetic algorithm for solving the Stochastic Dynamic Facility Layout Problem. The developed algorithm take into account both the layout for each period and the layouts for the complete set of periods being analyzed, by the introduction of two crossover and two mutation operators (one for each analysis).

11 - Risk-based Optimization Models for Post-disaster Patient Triage
Behrooz Kamali, PhD Candidate, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA, 24060, United States of America, kamali@vt.edu, Douglas Bish

This research is the first to systematically coordinate the regional response to a mass- casualty event. Using optimization models we develop response plans that reduce casualty risk by effectively using resources to triage and transport of casualties to hospitals. We have also integrated a surge capacity planning framework into our model.

12 - Design of HIV Prevention Intervention Campaigns Leveraging Social Networks
Ekkehard Beck, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, EkkehardBeck2015@u.northwestern.edu, Benjamin Armbruster

We study the spread of information for a new design of a HIV prevention intervention campaign on social networks. We derive managerial insights about an efficient campaign design studying the topology of the underlying social networks and various parameters of information spread.

13 - Evaluating Consumer Morbidity from Food Supply Chain Contamination
Jessye Bemley, North Carolina A&T State University, McNair Hall 419, 1601 East Market St., Greensboro, NC, 27411, United States of America, jlbemley@gmail.com, Lauren Davis, Raquel Teasley

This research aims to compare the vulnerabilities of three food distribution channels, in terms of consumer morbidity from consumption of an intentionally contaminated food item. A discrete time Markov Chain with rewards is presented to quantify the risk of exposure and the effect of a contaminant dose on the consumer.

14 - Incorporating Needs from Social Media in Static Disaster Relief Routing Problems
Emre Kirac, PhD Student, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ekirac@uark.edu, Clarence Wardell III, Ashlea Bennett Milburn

Disaster relief is not possible without actionable information. Collecting this information using sources such as on-the-ground assessment teams is time consuming. Social media usage has increased during disasters and can provide additional information about needs in a shorter amount of time, but such needs are not verified.This research evaluates the impact of considering unverified information in static routing problems. These approaches are compared across a variety of demand scenarios.

15 - Stochastic Inventory Systems with Cumulative Ordering Capacity Constraints
David Chen, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, chen2213@umn.edu, Rowan Wang, Saif Benjaafar

We consider stochastic inventory systems with a constraint on the cumulative order quantity over the entire planning horizon. We use an extended state-space analysis to characterize the structure of the optimal policy. We discuss the impact of the capacity constraint on cost and associated managerial implications. We also evaluate the benefit of using the optimal policy instead of simpler heuristics. We conclude by considering the joint capacity optimization and inventory control problem.

16 - A Nonparametric Method for an Inventory Problem with Unobserved Lost Sales
Arnab Bisi, Associate Professor of Operations Management, Indian Institute of Management Calcutta, Joka, Diamond Harbour Road, Kolkata, WB, 700104, India, abisi@iimcal.ac.in, Karanjit Kalsi, Golnaz Abdollahian

We determine the stocking quantities for a storable inventory problem with unobserved lost sales. An adaptive method for inventory decisions is proposed based on historical sales data. We establish the convergence rate of our policy for continuous demand distributions, and compare its performance against a benchmark and two existing policies.

17 - Integrated Woody Biomass-based Energy Logistics System
Zhongwei Yu, University of Missouri, 1133 Ashland Rd., Apt. 509, Columbia, MO, 65201, United States of America, zygd9@mail.missouri.edu, Wooseung Jang, Cerry Klein

A decision support system integrating both strategic network design and operational planning has been developed to optimize a woody biomass-based energy supply chain including harvesting, preprocessing, storage, and transportation. Geographic Information System is also integrated into the system to support the decision making process.

18 - Recency: When and How Advertisings Effect Sales
Hiroshi Kumakura, Professor, Chuo University, 742-1 Higashi-Nakano, Hachioji, Tokyo, 192-0393, Japan, kumakura@tamacc.chuo-u.ac.jp

"Recency," advertising short-term and direct effects on sales, works most, when advertisings reach audiences immediately before consumers' purchase; because advertisings and purchase are most closed in behavior and psychology at this time. This research discusses psychological mechanisms of recency and measures its duration with single-sourced advertisings and consumer purchase data.

19 - Integer Programming for Discrete Optimization of the Agile Supply Chain Configuration Problem
Hayden Beauchamp, Graduate Research Assistant, Texas State University-San Marcos, 601 University Dr, San Marcos, TX, 78666-2405, United States of America, hb1087@gmail.com, Farhad Ameri, Clara Novoa

The Digital Manufacturing Market (DMM) has been previously devised as an agent-based framework for supply chain configuration. When supplemented by a search agent, parameters like distance, capacity and technological competencies of suppliers can be modeled as a generalized assignment problem. Large-scale problems can be solved using the column generation approach.

20 - Lean Value Generation: A Case Study of North American Hospital Capabilities
David Barrett, PhD Candidate, Ivey Business School, 1551 Richmond Road, London, ON, N6A3K7, Canada, dbarrett.phd@ivey.ca

Distinct organizational capabilities enable the creation of lean potential in North American hospitals. Maximum value realization and operational effectiveness requires the application of implementation capabilities, while organizational effectiveness is moderated by environmental uncertainty. Four case studies provide qualitative data to support a conceptual research model grounded in operations management literature.

21 - Models and Solutions of the Course Allocation Problem
Hoda Atef Yekta, PhD Student, University of Connecticut, Hillside Road, Storrs, 06268, United States of America, hoda.atefyekta@business.uconn.edu

In the last decades, different business schools have tested several versions of the bidding point mechanisms (BPM) to allocate course seats to students. However, the BPM at times result in solutions with no course to some students, or some ones who can take all their desired courses and some others receive nothing. This research formulated the problem as a multi objective mathematical model considering both efficiency and fairness and proposed two heuristics to solve the problem.

22 - Improving Branching in MIP Solvers using Machine Learning Techniques

Pierre Le Bodic, Georgia Institute of Technology, Industrial Systems and Engineering, Atlanta, GA, 30332, United States of America, lebodic@gatech.edu, George Nemhauser

The purpose of this work is to use Machine Learning (ML) to build a branching rule which can make use of the information produced by all existing branching rules.

23 - Visualizing Structural Changes in North American Fertilizer Logistics

Sumadhur Shakya, Spatial Transportation Analyst/PhD Candidate, North Dakota State University, PO Box 6050, Fargo, ND, 58108, United States of America, Sumadhur.Shakya@ndsu.edu

Visualization of results helps in mapping of fertilizer supply chain as opposed to traditionally just looking at tabular data. Although tabular data is still the basis for analysis, visualization helps in calibration and verification of statistical model. Traditionally U.S. imports Nitrogen Fertilizers. Lower cost of natural gas from Fracking and add-in units to existing ethanol to produce N-fertilizer is disruptive and allows for potential for future exports.

24 - Method of Successive Modifications of Functional for Transportation Problem

Vladimir Tsurkov, Head of Department, Computing Center of Russian Academy of Sciences, Vavilov Street, 40, Moscow, 119333, Russia, tsur@ccas.ru, Alexander Tizik

Classical transportation problem is considered with additional points for suppliers and consumers. Main functional is augmented with expenses for transportation to these points. Appropriate variables specifying amounts of goods delivered to additional points are introduced. Method of successive modifications of functional is employed for solving since standard method yields laborious procedures. Sample is presented, which illustrates efficiency of the algorithm.

25 - Transactive Memory Systems: Information Sharing and its Effect on Team Performance

Courtney Williamson, PhD Student, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, cdwilliamson@cmu.edu

Transactive memory systems (TMS) facilitate teams' performances. However, few studies demonstrate how learning information about who knows what affects performance. The current laboratory studies manipulate information sharing. Study 1 finds a 3-way interaction between condition, performance time, and gender. Study 2 shows significant differences in TMS scores and performance errors.

26 - Opportunity Costs for Non-capital Resources in Job Sequencing: A TSP Approach for Improved Outcomes

James Burns, Doctoral Associate, Western Michigan University, 11731 Riverside Drive, White Pigeon, MI, 49099, United States of America, j.burns@wmich.edu

Sequencing jobs using a Traveling Salesman approach can be problematic as the size of the problem can increase quickly. This research presents a novel approach to TSP job sequencing using the Farthest Insertion Algorithm that improves the performance of a simulated job-shop production environment by incorporating a secondary objective.

27 - A Game-theoretic Queueing Exercise from Seinfeld

Bismark Singh, The University of Texas at Austin, 2900 Cole St., Austin, TX, 78705, United States of America, bismark.singh@utexas.edu, John Hasenbein

In the episode "Soup Nazi" of the sitcom Seinfeld customers face rejection for "misbehaving" in line. We analyze this queueing system from a customer's perspective by evaluating a hawk-and-dove style game theoretic approach and attempt to see under what conditions an evolutionary stable strategy is possible.

28 - On Optimal Fare Price Fencing in Airline Industry with Demand Leakages

Syed Asif Raza, Qatar University, College of Business and Economics, Doha, 2713, Qatar, syedar@qu.edu.qa

Differentiated fare pricing has been one of the most promising tools in airline industry with a successful history. However, most fare price differentiation strategies do not consider demand leakages between fare classes. Moreover, in most studies there is no cost assumed when an airline segments its demand into fare classes using a price differentiation. This research mainly addresses the issue of fare pricing differentiation in the presence of demand leakage and considers fencing issues.

29 - A New Adaptive Design for Environmental Sampling

Huijuan Li, Rutgers University, 2801 Merrywood Drive, Edison, 08817, United States of America, hli@stat.rutgers.edu, Hung Ying

The spatial distribution of a natural resource is an important consideration for designing an efficient survey in environmental sampling. A new adaptive design is proposed which is flexible and takes into account the spatial distribution to improve estimation efficiency. A New algorithm is introduced for the search of optimal designs. The proposed design and its efficiency are demonstrated by a water quality study.

30 - Supply Chain Bargaining Theory

Jud Kenney, McGill University, 4385 Decarie Blvd., Montreal, QC, Canada, jud.kenney@mail.mcgill.ca

The consensus among academic researchers is that supply chain management lacks grounding theory specific to its field and arguably enough to be recognized as an academic discipline. A new theory is developed from game theoretic, asymmetric Nash bargaining specific to operations and supply chain management: supply chain bargaining theory.

31 - Maintaining High Service Levels in Unbalanced Supply Chain

Abdulaziz Almaktoom, PhD Student, Wichita State University, 1845 Fairmount St., Wichita, KS, 67260, United States of America, atalmaktoom@wichita.edu, Samir Alsobhi, Krishna Krishnan

With an increasing complexity of supply chain systems, ensuring service level rate in factories throughout the supply chain network is of vital importance in practical supply chain management. This research studies the effect of supplies availability through the supply chain and its impact on the supply chain service level. A case study is proposed and analyzed to define which factory should be improved to enhance the overall service level of the supply chain network.

32 - A Nested Approach in Developing an Index to Measure "National Sustainable Transport

Hamed Ahangari, Graduate Assistant, University of Connecticut, 1 Northwood Rd., Storrs, CT, 06268, United States of America, h.ahangari@gmail.com, Hoda Atef Yekta, Norman W. Garrick

Recently, sustainability concerns become very popular in different areas such as transportation. This research tries to develop a framework to measure the sustainability of transportation system by developing a composite index in international scale. This index is made by 7 environmental, 8 social, and 4 economic indicators. The nested sustainability approach is employed to evaluate stability of sustainability. Finally econometrics models is used to determine sustainability contributing factors.

33 - Managing Rail-truck Intermodal Transportation for Hazardous Materials with Congestion Considerations

Ghazal Assadipour, PhD Student, Memorial University of Newfoundland, 4017, 216 Prince Philip Drive, St. John's, A1B3R5, Canada, ghazal.assadipour@mun.ca, Ginger Ke, Manish Verma

This research analyzes the problem of capacity planning and routing of regular and hazardous materials in a rail-truck intermodal network when the demand for transportation is stochastic. The novel feature of the suggested model is the consideration of congestion, as a source of exposure and delay, when making equipment acquisition and routing decisions. We illustrate the application of the model using a real problem instance based on the intermodal service chain of Norfolk Southern in US.

34 - Berth Allocation Problem under Stochastic Nature

Evrim Ursavas, University of Groningen, Groningen, Netherlands, e.ursavas@rug.nl, Stuart X. Zhu

Berth management drives the port operations and the major objective for this process is to determine the optimal location in order to minimize berthing times for the vessels. In this study, we propose a framework based on stochastic dynamic programming approach to model the problem and characterize optimal polices under stochastic arrival and handling times. A heuristic based relaxation is proposed to confront dimensional computational complexity. We illustrate our methodology via a case study.

35 - Highway Patrol Routing

Poyraz Kayabas, North Dakota State University, Fargo, ND, United States of America, poyraz.kayabas@ndsu.edu

Objective is to develop a model for highway patrol troopers to preserve a certain level of visibility in order to maintain general deterrence and detection of traffic and criminal violations. This poster presents a GIS-based vehicle routing model with non-cost based objective functions for this problem.

36 - A Link-based Approach for Evaluating Accessibility to Emergency Services in a Transportation Network

David Novak, University of Vermont, Burlington, VT, United States of America, dnovak@bsad.uvm.edu, Jim Sullivan

The authors utilize network science, location science and transportation-based accessibility principles to create a new performance measure to help decision-makers evaluate the relative importance of each link in a roadway network with respect to its system-wide contribution to emergency service accessibility under link disruption scenarios. The measure accounts for the spatial distribution of important / critical nodes, the topology of the road network, geographical topography and the characteristics of the road network such as road types, capacities, volumes and travel speeds. The authors demonstrate their methodology using geographic information system (GIS) mapping and travel-demand modeling software with an actual state travel demand model and road network.

37 - Exchange of Demand Information in a Supply Chain with Learning Effect
Jianghua Wu, Associate Professor of Operations Management, School of Business, Renmin University of China, Beijing, 100872, China, jwu@ruc.edu.cn

We study the incentive for information sharing across decentralized retailers in a supply chain with learn-by-doing effect along with the upstream manufacturer. The wholesale price in the second period is decreasing in the aggregate order size in the first period due to the learning effect. We show that in general retailers have no incentive to share their private demand information. However, partial or full information sharing may be the dominant strategy under boundary equilibrium.

38 - A Retrospective on the Maximal Covering Location Problem Applied to Habitat Reserve Selection
Stephanie Snyder, Operations Research Analyst, USDA Forest Service, 1992 Folwell Avenue, St. Paul, MN, 55108, United States of America, stephaniesnyder@fs.fed.us, Robert Haight

The Maximal Covering Location Problem (MCLP) (Church and ReVelle, 1974) is a classic model from the location science literature which has found wide application. One application is to a fundamental problem in conservation biology, the Maximum Covering Species Problem (MCSP) (Church et al. 1996, Camm et al. 1996), which identifies land parcels to protect to maximize the number of species represented in the selected sites. We trace the evolution of the MCSP from the MCLP and review extensions.

39 - When Is Radionuclide Bone Scan Needed for the Baseline Staging of Newly Diagnosed Prostate Cancer?
Selin Merdan, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, smerdan@umich.edu, Brian Denton, David C. Miller, Susan Linsell, Zaojun Ye, James Edward Montie

Radionuclide bone scans are often performed in the staging evaluation of patients with newly diagnosed prostate cancer, but not all patients are at the same risk of harboring bone metastases. This poster will present a study of methods to predict bone scan findings using prostate-specific antigen levels and other clinical parameters, and to identify the subgroup of patients for whom a baseline staging bone scan may be safely omitted without compromising the ability to detect metastatic disease.

40 - Optimal Batch Processing Stochastic Gradient Method Towards Online Brain Computer Interface
Fatemeh S. Hashemi, Virginia Tech, 312 Hunt Club Road 4000k, Blacksburg, VA, 24060, United States of America, fatemeh@vt.edu, Raghu Pasupathy

We consider the problem of classifying EEG signals recorded from fully-paralyzed patients, towards a functional brain-computer interface. We pose the problem as that of identifying parameters for a Bayesian classifier specified through a Gaussian mixture model. The solution methodology is simulation optimization where a deterministic optimization recursion is embedded with strategic sampling to ensure rapid convergence to the optimal solution.

Monday, 1:30pm - 3:00pm

■ MC01

Level 2 - Room 200A

Optimization, Spatial Analysis and GIS 3

Cluster: Optimization, Spatial Analysis and GIS

Invited Session

Chair: Alan Murray, Arizona State University, Tempe, AZ, United States of America, atmurray@asu.edu

1 - Math Programming Approaches to the Art Gallery Problem: Formulations, Heuristics, and Results
Amir Kalantari, University of Wisconsin-Milwaukee, PO.Box 784, Milwaukee, United States of America, kalanta2@uwm.edu, Matthew Petering, Hamid Seifoddini

The art gallery problem is a classic mathematical problem that has been investigated from many perspectives. Many algorithms have been developed to solve different variations of the problem. Most of these algorithms identify a sufficient number of guards that can cover the entire area. We develop an integer programming model that is able to find the maximum coverage area for a given number of guards. Unlike other algorithms, our model is versatile and can accommodate many different assumptions.

2 - Analyzing Fire Service Deployment in Los Angeles County
Richard Church, Professor, University of California, Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106-4060, United States of America, church@geog.ucsb.edu, WenWen Li

This paper presents the use of a combination of approaches, including cybersearch, GIS, and optimization to analyze fire service deployment within the county of Los Angeles, covering all municipal jurisdictions. Station coverage is analyzed in terms of whether imporovements can by limited station relocation.

3 - Navigating Complex Environments
Alan Murray, Arizona State University, Tempe, AZ, United States of America, atmurray@asu.edu, Insu Hong

This paper discusses the problem of wayfinding and navigation in a complex environment. GIS based methods are developed to address this problem, leading to substantial computational advances. Application results are presented.

4 - Between Terrain and a NP-hard Place: Challenges of Solving Multi-objective Shortest Paths on GIS Data
F. Antonio Medrano, PhD candidate, UCSB, 1832 Ellison Hall, Santa Barbara, CA, 93106, United States of America, medrano@geog.ucsb.edu, Richard Church

The multi-objective shortest path (MOSP) problem involves solving for a set of pareto-optimal paths between multiple objectives, and is NP-hard for computing all solutions. The literature has tested exact algorithms for MOSP on random and road networks, but very little using GIS-sourced terrain-based data. We discuss the unique properties of GIS networks and problems that emerge when solving MOSP on them, and present improvements to exact methods that address these challenges when run on a GIS.

■ MC02

Level 2 - Room 200B

IOS Awardee Presentations

Sponsor: Optimization

Sponsored Session

Chair: Sanjay Mehrotra, Northwestern University, 2165 Sheridan Rd., Evanston, IL, 60202, United States of America, mehrotra@northwestern.edu

1 - Optimization Society Student Paper Prize – Afonso Bandeira
Simge Küçükyavuz, The Ohio State University, Dept. of Integrated Systems Eng., 210 Baker Systems Building 1971 Neil Ave., Columbus, OH, 43210, United States of America, kucukyavuz.2@osu.edu

Afonso Bandeira (Princeton University) is selected as the winner of the 2013 INFORMS Optimization Society Student Paper Prize for his paper "Computation of Sparse Low Degree Interpolating Polynomials and their Application to Derivative-Free Optimization," with Katya Scheinberg and Luis N. Vicente. The novelty of this paper is in the application of sparse signal recovery to the construction of polynomial interpolation models of functions with sparse Hessians. In general, constructing an accurate second-order interpolation model of a smooth function requires O(n^2) samples. Bandeira et al. show that if the Hessian contains only s nonzeros, then using sparse recovery via l-1 minimization, one can construct an accurate second-order model using only O(s log^4(n)) samples. When applied to derivative-free optimization, the techniques developed significantly reduce the number of evaluations necessary for function approximation via sampling, and thus accelerate the optimization of complex systems such as those whose objective functions are calculated by a costly black-box simulation.

2 - The INFORMS Optimization Society Prize for Young Researchers – Jim Luedtke
Alper Atamturk, Professor, University of California, Berkeley, 423 Sutardja Dai Hall, Berkeley, 94720-1758, United States of America, atamturk@berkeley.edu

The 2013 recipient of the Prize for Young Researchers of the INFORMS Optimization Society is Jim Luedtke, for his paper "A Branch-and-Cut Decomposition Algorithm for Solving Chance-Constrained Mathematical Programs with Finite Support," Mathematical Programming (2013), DOI 10.1007/s10107-013-0684-6. Although chance (probabilistic) constraints are very useful in modeling uncertainty, they often lead to notoriously difficult non-convex optimization problems. The cited paper proposes an exact and surprisingly effective algorithm for optimization over chance constraints. In his PhD thesis Jim Luedtke gave an effective cutting plane approach to solve chance-constrained optimization problems with right-hand-side uncertainty. In the current paper, the author shows a clever way of integrating cutting plane and decomposition methods to handle the much more difficult matrix uncertainty case with surprising effectiveness. Numerical implementation demonstrates the proposed approach to be of orders of magnitude faster than standard modeling and decomposition approaches for optimization with chance constraints. The cited paper has the potential to make a very significant impact in the numerical solution of a broad class of stochastic optimization problems.

3 - The Farkas Prize of the INFORMS Optimization Society – Pablo Parrilo

Dimitris Bertsimas, Boeing Leaders for Global Operations Professor, Massachusetts Insitute of Technology, Sloan School of Management, 77 Massachusetts Ave., E40-147, Cambridge, MA, 02139, United States of America, dbertsim@mit.edu

The 2013 Farkas prize is awarded to Pablo Parrilo for his significant and fundamental contributions to the field of optimization. His work builds new bridges between semidefinite optimization and real algebraic geometry, and expands the impact and applications of optimization to new areas of engineering, control theory, and recently machine learning. Parrilo's contributions span areas as diverse as game theory and quantum computation. In his PhD thesis, building on prior fundamental work by N.Z. Shor and Y. Nesterov, Parrilo showed that semidefinite optimization can be combined with Positivstellensaatze results (in reference to the seminal work of Hilbert around 1900) of real algebraic geometry to solve polynomial optimization problems with arbitrary accuracy. Parrilo has continued to produce a large number of high quality scientific papers at the interface of algorithmic algebra and optimization: an approach for using invariant theory for exploiting symmetry in algebraic problems (with Gatermann); proof of the Lax conjecture (posed in 1958) about determinantal representations of hyperbolic polynomials in three variables (with Lewis and Ramana); a polynomial time approximation scheme for minimizing forms on the simplex (with de Klerk and Laurent); extending Lovasz's theta body of the stable set polytope to convex hulls of arbitrary algebraic varieties (with Gouveia and Thomas); and a complete characterization of the gap between convexity and SOS-convexity, analogous to Hilbert's seminal result for positive polynomials (with Ahmadi).

4 - The Khachiyan Prize for Lifetime Accomplishments in Optimization – Donald Goldfarb and Alexander Shapiro

Jorge Nocedal, Professor, Northwestern University, Evanston, IL, United States of America, nocedal@eecs.northwestern.edu

Donald Goldfarb has made fundamental contributions to the field of continuous optimization through the design and analysis of innovative algorithms, including the celebrated BFGS quasi-Newton method for nonlinear optimization and the steepest edge simplex method for linear programming. Alexander Shapiro has been one of the most prolific scholars in the field of Operations Research, contributing significantly to nonlinear analysis (specifically sensitivity and optimality), and to stochastic programming, where his work on complexity analysis and risk-averse decision making has been highly influential. Community Member Log-in: Forgot your username or password Participate in Communities You are here: Home Community Optimization Society Optimization Society Prizes Student-Paper-Prize 2013 Afonso Bandeira is selected as the winner of the 2013 INFORMS Optimization Society Student Paper Prize Citation Afonso Bandeira (Princeton University) is selected as the winner of the 2013 INFORMS Optimization Society Student Paper Prize for his paper "Computation of Sparse Low Degree Interpolating Polynomials and their Application to Derivative-Free Optimization," with Katya Scheinberg and Luis N. Vicente. The novelty of this paper is in the application of sparse signal recovery to the construction of polynomial interpolation models of functions with sparse Hessians. In general, constructing an accurate second-order interpolation model of a smooth function requires O(n^2) samples. Bandeira et al. show that if the Hessian contains only s nonzeros, then using sparse recovery via l-1 minimization, one can construct an accurate second-order model using only O(s log^4(n)) samples. When applied to derivative-free optimization, the techniques developed significantly reduce the number of evaluations necessary for function approximation via sampling, and thus accelerate the optimization of complex systems such as those whose objective functions are calculated by a costly black-box simulation.

■ MC03

Level 2 - Room 200C

Global Optimization in Graphs/Networks

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Sergiy Butenko, Associate Professor, Texas A&M University, Industrial & Systems Engineering, 3131 TAMU, College Station, TX, 77843, United States of America, butenko@tamu.edu

1 - On Connected Dominating Sets of Restricted Diameter

Je Sang Sung, Texas A&M University, Industrial & Systems Engineering, 3131 TAMU, College Station, TX, 77843, United States of America, je.sung@tamu.edu, Vladimir Boginski, Austin Buchanan, Sergiy Butenko

A connected dominating set (CDS) is commonly used as a virtual backbone in the context of wireless networks. We explicitly restrict the diameter of a CDS to be no more than s leading to the concept of a dominating s-club (DsC). We show that the problem of checking the existence of a DsC is NP-complete for any fixed positive integer s. We also show that the problem of finding a minimum DsC is NP-hard, even when restricted to graphs for which a dominating clique is known to exist.

2 - An Integer Programming Approach for K-Connected m-Dominating Sets

Austin Buchanan, Texas A&M University, Industrial & Systems Engineering, 3131 TAMU, College Station, TX, 77843, United States of America, buchanan@tamu.edu, Je Sang Sung, Sergiy Butenko

We study the minimum k-connected m-dominating set(kmCDS) problem. A kmCDS is a fault-tolerant connected dominating set (CDS). We give three exponentially-sized IP formulations based on vertex-cuts (depending on whether $m < k$, $m = k$, or $m > k$) and study their integer hulls. Finally, we show that a lazy-constraint approach compares favorably with existing approaches for the minimum CDS problem (the case $k = m = 1$ in our problem). We present computational results for $k = m = 2$; 3; 4 as well.

3 - On Distance-based Clique Relaxations in Unit Disk Graphs

Yiming Wang, Texas A&M University, 809 San Saba Drive, College Station, TX, 77845, United States of America, kkelvin@tamu.edu, Jeffrey Pattillo, Sergiy Butenko

Distance-based clique relaxations in unit disk graphs arising in wireless networking applications are studied. A 0.5-approximation algorithm for the maximum 2-clique problem in unit disk graphs is developed, and polynomial solvability of the minimum dominating set problem in unit disk graphs of diameter two is established. The same problem is shown to be hard in general diameter-two graphs.

■ MC04

Level 2 - Room 200D

Robust Optimization and Approximation

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, xsun84@isye.gatech.edu

1 - On the Performance of Affine Policy for Adaptive Optimization: A Geometric Perspective

Hoda Bidkhori, Massachusetts Institute of Technology, Cambridge, MA, 02139, United States of America, bidkhori@mit.edu, Dimitris Bertsimas

In this presentation, we consider two-stage adjustable robust linear optimization problems with uncertain right hand side belonging to a convex and compact uncertainty set U. We provide an approximation bound on the ratio of the {optimal affine solution} to the optimal adjustable solution that depends on two fundamental geometric properties of U and provides deeper insight on the power of affine policies for this class of problems.

2 - Robust SAA

Nathan Kallus, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Ave., E40-149, Cambridge, MA, 02139, United States of America, kallus@mit.edu, Dimitris Bertsimas, Vishal Gupta

The sample average approximation (SAA) approach to data-driven optimization generally enjoys convergence as the sample size grows infinitely, but lacks finite-sample performance guarantees that apply as generally. We present a robustification of the SAA using tools of statistical testing, gaining generic probabilistic guarantees without losing SAA's wide-applicability, convergence, and tractability. The convergence of guarantees suggests that they are not overly conservative.

3 - Affine Policies and Constraint Generation for the Multistage Adaptive Robust Unit Commitment Problem

Alvaro Lorca, Operations Research PhD Student, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, alvarolorca@gatech.edu, Andy Sun

The uncertain nature of multiple factors such as wind power generation and electricity demand makes the operation of power systems highly challenging. In this talk we present a multistage adaptive robust approach for the unit commitment problem under uncertain net electricity demands. We consider families of approximate affine policies for dealing with this hard problem and a solution method based on constraint generation with several algorithmic improvements.

■ MC05

Level 2 - Room 200E

Clique Relaxation Models in Networks

Sponsor: Optimization/Networks

Sponsored Session

Chair: Vladimir Boginski, Assistant Professor, University of Florida, 1350 N Poquito Rd., Shalimar, FL, 32579, United States of America, boginski@reef.ufl.edu

1 - On S-plex and S-defective Clique Numbers of a Graph

Oleg Shirokikh, Ph.D. Candidate, University of Florida, 989 Tahoe Boulevard, Unit 37L, Incline Village, NV, 89451, United States of America, olegshirokikh@ufl.edu, Austin Buchanan, Sergiy Butenko, Vladimir Boginski

We consider the problems of finding the maximum s-plex and the maximum s-defective clique in a graph. These problems consider important types of hereditary clique relaxations that have applications in network-based data mining. Extensive theoretical and computational results are presented.

2 - Maximum Degree-based Gamma-quasi-Clique Detection Problem

Grigory Pastukhov, Research Assistant, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, gpastukhov@ufl.edu, Oleg Prokopyev, Vladimir Boginski, Alexander Veremyev

We consider degree-based clique relaxation called gamma-quasi-clique. Gamma-quasi-clique is a subgraph such that each node has a degree at least gamma*(n-1), where n is the number of nodes in the subgraph. We prove that the maximum gamma-quasi-clique problem is NP-complete, and develop heuristic and exact branch-and-bound algorithm for this problem.

3 - A Decomposition Algorithm for the Maximum K-club Problem

Esmaeel Moradi, Student, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74075, United States of America, esmaeel.moradi@mail.okstate.edu, Baski Balasundaram

A subgraph of diameter at most "k" is called a k-club, which includes clique as a special case when k equals 1 and is a relaxation when k is larger than 1. This graph theoretic clique relaxation can be used to model low-diameter clusters in graph based data mining applications in bioinformatics and social network analysis. This talk discusses a decomposition approach to solve the integer programming formulation of this problem and presents preliminary computational results.

4 - New Developments on the Maximum Quasi-clique Problem

Zhuqi Miao, Oklahoma State University, 322 Engineering North, Oklahoma State Un, Stillwater, OK, 74078, United States of America, zhuqi@ostatemail.okstate.edu, Baski Balasundaram

Quasi-clique is a useful model for cluster detection in real-life networks when the clique model is overly restrictive. This talk discusses the development of a new upper-bounding technique for the maximum quasi-clique problem using Lagrangian duality and constraint generation to a quadratically constrained formulation of this problem. The results could be used to enhance existing exact algorithms.

■ MC06

Level 2 - Room 200F

Multiobjective Optimization Applied in the Industry through the use of Metaheuristics

Sponsor: Optimization/Linear Programming and Complementarity

Sponsored Session

Chair: Diana Ramirez, Chief Science Officer, FCIMEC, Carrera 53 No.74-86 Office 402, Barranquilla, At, 080020, Colombia, dramirez@fcimec.org

1 - Decision Support System (DSS) for Planning and Programming Projects in the Construction Industry.

Miguel Jimenez, FCIMEC, Carrera 53 No.74-86 Office 402, Barranquilla, At, 080020, Colombia, mjimenez@fcimec.org, Esneyder Gonzalez, Libardo Gomez, Andres Palmieri, Ricardo Moreno, Diana Ramirez, Fernando Gonzalez

A DSS was developed for a construction company, which considers the Budget, Programming and Control modules. This DSS is in charge of organizing the budget of any project, through the calculation of its estimated unit cost and time per activity. These activities are programmed under multiobjective optimization, where a metaheuristic solution is implemented. In the control module, the activities can be visualized in a PERT diagram by the programmer. Results of projects implemented are shown.

2 - Multiobjetive Optimization of the Resource Constrained Project Scheduling Problem (RCPSP)

Diana Ramirez, Chief Science Officer, FCIMEC, Carrera 53 No.74-86 Office 402, Barranquilla, At, 080020, Colombia, dramirez@fcimec.org, Fernando Gonzalez, Andres Palmieri, Libardo Gomez, Miguel Jimenez, Esneyder Gonzalez, Fabio Monroy

RCPSP under multiple objectives is considered in this research, where both cost and time need to be minimized. The mathematical formulation and metaheuristic solution approach based on bacteria fototaxis is presented in this paper. The functions to be minimized are makespan and resource investment cost. A case study presented in a construction company demonstrates the need for multi-objective optimization as a support for decision making.

3 - Optimization of Logistic Operations of a Company that Carries Environmentally Hazardous Materials.

Lauren Castro, FCIMEC, Carrera 53 No.74-86 Office 402, Barranquilla, At, 080020, Colombia, ljcastro@fcimec.org, Jairo Montoya, Linda Castro, Santiago Nieto, Diana Ramirez, Nilson Herazo

In a company that transports environmentally hazardous materials, the optimization was aimed for the assignment and distribution of their tanks, through the use of metaheuristics. It both considers a high service level and the minimization of the costs of transportation. The results for this research project demonstrate an efficient use of the tanks through optimized logistic operations.

4 - Multi-objective Optimization of a Warehouse in Pharmaceutical and Cosmetics Industry.

Luis Ramirez, FCIMEC, Carrera 53 No.74-86 Office 402, Barranquilla, At, 080020, Colombia, lramirez@fcimec.org, Miguel Jimenez, Erik Maldonado, Fernando Gonzalez, Diana Ramirez, Lauren Castro

An a approach to a typical warehouse problem was considered by using both heuristics and metaheuristics, were efficiency is given by the best arrangement of items in the warehouse (slotting) and the best picking routes selected for each order (picking). Through the integration of both simulation and optimization models, a computational procedure was developed, were the results consider a significant increase in the picking and slotting processes of the warehouse.

■ MC07

Level 2 - Room 200G

Information Theory and Optimization

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Eugene Perevalov, Lehigh University, 200 W Packer Ave., Bethlehem, PA, 18015, United States of America, eup2@lehigh.edu

1 - Mutual Information Based Causal Inference with Continuous Observational Data

Alexander Nikolaev, Assistant Professor, University at Buffalo (SUNY), 312 Bell Hall, Buffalo, NY, 14260-2050, United States of America, anikolae@buffalo.edu, Lei Sun

In observational causal inference, bias reduction can be achieved via matching groups of units under study. This paper describes a matching method based on minimizing mutual information (MI) between the units' covariates and treatment indicators, which requires discretizing continuous covariates using bins. However, as in many other applications, binning can lead to bias by itself. The paper addresses this issue by presenting MI based matching with adaptive binning.

2 - On the Minimal Invariance Entropy of a Subspace for Multi-channel Systems

Getachew Befecadu, Research Assistant Professor, University of Notre Dame, Department of Electrical Engineering, Cushing Hall 221, Notre Dame, IN, 46556, United States of America, gbefekadu1@nd.edu

We investigate a Nash equilibrium in feedback strategies that imposes minimal dynamics, in the sense of minimal invariance entropy of a given subspace, for multi-channel systems. We present a sufficient condition for the existence of Nash equilibria, when the criterion is the minimal invariance entropy of a given subspace. Such an interpretation offers an intrinsic measure of information how is difficult to keep the system states near a given subspace with respect to the control input channels.

3 - Information Acquisition for Optimizing New Technology Adoption in Equipment Replacement

Thomas Yeung, Associate Professor, Ecole des Mines de Nantes, 4 Rue Alfred Kastler, BP 20722, Nantes, 44307, France, thomas.yeung@mines-nantes.fr, Bruno Castanier, Khanh Nguyen

Uncertain technology evolution strongly impacts asset replacement decisions as there is risk in replacing too early or too late. We investigate the optimal timing of information acquisition on new technology and how it affects equipment operation and replacement decisions. We develop a non-stationary Markov decision process model and provide analytical properties and sensitivity analysis on the optimal policy for information acquisition and illustrate them through numerical examples.

4 - On the Theory of Information Accuracy: Information Sources and their Knowledge Structures

Eugene Perevalov, Lehigh University, 200 W Packer Ave., Bethlehem, PA, 18015, United States of America, eup2@lehigh.edu

The classical Information Theory found a consistent way to describe information quantity regardless of its content. This made it a theoretical foundation of optimal transmission. On the other hand, to obtain a similar theoretical foundation of information acquisition and usage, it is necessary to find ways to describe information accuracy and relevance. We address the former information characteristic and discuss how a theory of optimal information acquisition can be developed.

5 - Heredity and Provenance Detection of Binary Codes, a Network Science Based Approach

Liying Cui, Senior Project Manager, Starbucks Coffee Company, 2401 Utah Ave. S, S-SC6, Seattle, WA, 98134, United States of America, cui.liying@gmail.com, Soundar Kumara

We propose a network based method to detect the heredity, provenance and variants of binary codes. Though semantic and context based approaches exist to identify the nature of software, methods to relate binary codes are sparse. Science for identifying the relationship between binary codes is in early stages. We present a networks based approach to relate binary codes, which will form the foundation to identify the relationship between binary codes and to develop mitigation strategies.

■ MC08

Level 2 - Room 200H

Modeling Systems I

Sponsor: Computing Society

Sponsored Session

Chair: Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01609, United States of America, atrapp@wpi.edu

1 - Computing in Operations Research using Julia

Miles Lubin, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-149, Cambridge, MA, 02139, United States of America, mlubin@mit.edu, Iain Dunning

Julia, a new high-level programming language for scientific computing, claims to bridge the performance gap between languages such as Python and MATLAB and low-level languages such as C and C++. We will evaluate these claims in the context of algorithms and software fundamental to the field of operations research, including the simplex method and algebraic modeling. We provide extensive cross-language benchmarks and comparisons with state-of-the-art modeling packages such as AMPL and Pyomo.

2 - Automated Learning of Algebraic Models for Optimization

Alison Cozad, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, United States of America, acozad@andrew.cmu.edu, Nick Sahinidis

What often hinders the application of algebraic models and advanced optimization algorithms is the lack of algebraic formulations. Practitioners often find it easier to develop simulation models. To expand the range of application of algebraic modeling systems and optimization algorithms, we have developed ALAMO (Automated Learning of Algebraic Models for Optimization). This tool iteratively generates surrogate models from simulations or experiments that are tailored for algebraic optimization.

3 - New Features in OPTMODEL: Parallel Coroutines and Semantic Modeling

Leo Lopes, Advanced Analytics Specialist, SAS Institute, SAS Campus Drive, Cary, NC, 27513, United States of America, Leo.Lopes@sas.com

With one new keyword, OPTMODEL from SAS creates threads that collaborate to run solvers in parallel and execute user code serially. Thus, you do not need to worry about process management or resource contention. You can also access many specialized solvers by directly tying variables and parameters to problem definitions, rather than by providing traditional explicit formulations. OPTMODEL supports many problems from Network Optimization, Combinatorial Optimization, and Parameter Estimation.

■ MC09

Level 2 - Room 200I

Innovative Applications in Analytics Award III

Sponsor: Analytics Section

Sponsored Session

Chair: Pooja Dewan, General Director, Burlington Northern Santa Fe Corporation, 2400 Western Center, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

1 - Innovative Applications in Analytics Award

Pooja Dewan, General Director, Burlington Northern Santa Fe Corporation, 2400 Western Center, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

The purpose of the third annual Innovative Applications in Analytics Award is to recognize creative and unique developments, applications or combinations of analytical techniques used in practice. The prize promotes the awareness of the value of analytics techniques in unusual applications, or in creative combination to provide unique insights and/or business value. These three sessions in the INFORMS annual meeting will be focused on having the 9 Semi-finalists of the award present their work to a panel of judges. At the end of the sessions, the judges will deliberate and determine the 3 Finalists that will present in the Spring INFORMS of 2014.

2 - A SMS Text Classification System for UNICEF Uganda

Prem Melville, IBM Research, Machine Learning Group, Yorktown Heights NY, United States of America, Rajesh Anandan, Solomon Assefa, Vijil Chenthamarakshan, Rick Lawrence, James Powell, Sharad Sapra

3 - A Novel Machine Learning Methodology for Sentiment Analysis

Shyamal Krishna,Hewlett-Packard, Platform Services, Global Analytics

The classical lexicon-approach used for sentiment analysis is limited in its application as it requires numerous case specific-rules to understand the usage of words for expressing opinions. Here 'Support-Vector-Machines', a machine-learning based technique, is used to automatically generate sentiments and underlying themes based on a sample provided by the user.

4 - Price & Revenue Optimization for One of the Largest Acquiring Banks in South America

Suman Kumar Singh,Fiserv, Tarang Goyal, Aditya Khandekar

The Merchant Acquirer had ~1million merchants in mass market. An opportunity existed to selectively optimize price for merchants based on certain attributes. A statistical segmentation was developed following which non-linear differential price elasticity function was built. For each segment, price elasticity along with an optimization algorithm with complex constraints was developed to optimize price and achieve optimal revenue.

■ MC10

Level 2 - Room 200J

CAP and Continuing Educations

Sponsor: CPMS, The Practice Section

Sponsored Session

Chair: Jack Levis, Director, Process Management, UPS, 2311 York Road, Timonium, MD, 21093, United States of America, jlevis@ups.com

Chair: Stephen Powell, Dartmouth College, Amos Tuck School of Business, Hanover, NH, United States of America, Stephen.G.Powell@tuck.dartmouth.edu

1 - Certified Analytics Professional Certification

Jack Levis, Director, Process Management, UPS, 2311 York Road, Timonium, MD, 21093, United States of America, jlevis@ups.com

After working for more than two years, INFORMS held its first Certified Analytics Professional (CAP) certification exam in San Antonio. This presentation will discuss CAP certification program and plans going forward. The session will be an interactive session with the audience to inform as well as seek feedback.

2 - Continuing Education

Stephen Powell, Dartmouth College, Amos Tuck School of Business, Hanover, NH, United States of America, Stephen.G.Powell@tuck.dartmouth.edu

INFORMS initiated the process of creating a Continuing Education program in the spring of 2012. The highlights of our progress since that time include hiring a Manager for Continuing Education and creating two workshops: one Data Exploration and another on Professional Skills. I will provide an update on our accomplishments and plans in this area and solicit feedback on what types of continuing education offerings would be most valuable to members.

■ MC11

Level 2 - Room 201A

Optimization Models Deployed as Web-based Applications and on Mobile Platforms

Sponsor: Computing Society

Sponsored Session

Chair: Bjarni Kristjansson, Maximal Software, Inc., 2111 Wilson Boulevard, Suite 700, Arlington, VA, 22201, United States of America, bjarni@maximalsoftware.com

1 - Deploying MPL Optimization Models on Servers and Mobile Platforms

Bjarni Kristjansson, Maximal Software, Inc., 2111 Wilson Boulevard, Suite 700, Arlington, VA, 22201, United States of America, bjarni@maximalsoftware.com

The IT industry is currently undergoing a major shift, away from traditional standalone applications, to new platforms such as servers, clouds, tablets, and mobile phones. We will demonstrate a new server-based version of the MPL OptiMax Component Library, that makes implementing real-world optimization applications a relatively quick and easy process. We will take you through all the steps of implementing optimization projects, including formulating the model, integrating it seamlessly with data in different formats, and then finally deploying the project on a server for servicing both web and mobile clients, using standard programming languages, such as CSharp, Visual Basic, C/C++, or Python.

2 - Real-world Optimization Models Formulated and Deployed as Web-based Applications using MPL OptiMax

Sandip Pindoria, Maximal Software, Ltd., Boundary House, Boston Manor, London, W7 2QE, United Kingdom, sandip@maximalsoftware.co.uk, Bjarni Kristjansson

MPL is a modeling system that allows the model developer to efficiently formulate complicated optimization models. We will demonstrate some real-world MPL models that have been formulated as web-based applications using the MPL OptiMax Component Library. A Portfolio Optimization model will be explored and shown how it can be iterated to produce a trade-off curve (Efficient Frontier) between the Return and Risk. A Vehicle Routing application with multiple vehicles and depots. We will also demonstrate a Nurse Rostering application with multiple contract rules and objective criterias.

3 - Radio Frequency and Time-slot Assignment in Mobile Adhoc Networks: An Exact Mathematical Solution

David Foroudi, Ph.D., Consultant, Greater Los Angeles Area, Los Angeles, CA, United States of America, adforoudi@gmail.com

Consider a centrally managed network of multi-band/multi-mode radios, required to broadcast messages with their neighboring nodes at distinct frequencies/time-slots and under several bottleneck constraints. We developed mathematical model in MPL/CPLEX for assigning frequencies to radios at each timeslot, formulated as bottleneck generalization of the famous Map Coloring problem in Combinatorial Optimization. We were able to solve this quickly even though computational complexity is NP-Complete.

■ MC12

Level 2 - Room 201B

SpORts - Comparing Sports Performances and Records

Sponsor: SpORts

Sponsored Session

Chair: Bret Myers, Assistant Professor of Management and Operations, Villanova University, 204 Eagle Glen Drive, Coatesville, PA, 19320, United States of America, bret.myers@villanova.edu

1 - A Sensitivity Analysis of Three Quarterback Rating Statistics

Laura McLay, Associate Professor, University of Wisconsin-Madison, Industrial & Systems Engineering, Madison, WI, 53706, United States of America, lmclay@wisc.edu, John Angelis

Quarterbacks can be difficult to rank due to the influence of random events on their input statistics. To investigate this variance, we perform a sensitivity analysis of three quarterback rating statistics: the Traditional rating by Smith, the Burke, and the Wages of Wins ratings. We make comparisons at the team level using data from 2002-2011. We compute ratings with 1-5 additional touchdowns, 1-5 fewer interceptions, 1-5 additional sacks, and a 1-5% increase in the passing completion rate.

2 - A Relationship between DEA and Sabermetrics in Evaluation of Baseball Players

Hirotsu Nobuyoshi, School of Health and Sports Science, Juntendo University, Hiragagakuendai, 270-1695, Inzai, Japan, nhirotsu@hotmail.com, James Cochran

Data envelopment analysis (DEA) has been applied to evaluate baseball players' performance, and Sabermetrics are widely used to find characteristics of players. To understand the relationship between DEA and Sabermetrics will be an interesting topic in evaluation of players. This talk will show the relationship using data of Major League Baseball, and discuss how DEA approach could help to get a clue to find new Sabermetric measures.

3 - Using Analytical Hierarchy Process (AHP) to Determine the Most Outstanding Sports Record

Bret Myers, Assistant Professor of Management and Operations, Villanova University, 204 Eagle Glen Drive, Coatesville, PA, 19320, United States of America, bret.myers@villanova.edu, Robert Nydick, Howard Weiss, Matthew Liberatore, Brian Coughlin

What is the greatest sports record of all time? This is an ageless debate that continuously garners attention from media and sports fans alike. We present an AHP-based approach to address this question. We build on the work of Golden and Wasil (1987) and limit our focus to the four major American sports: MLB, NBA, NFL, and NHL. Our ranking process involves input from "experts" including renowned Sports Illustrated writer Jack McCallum.

4 - An Examination of the Relative Age Effect (RAE) in Texas High School Swimming

James Cochran, Louisiana Tech University, Ruston, LA, United States of America, jcochran@latech.edu, Lauren Brewer

The RAE is the phenomena that explains the competitive disadvantages faced by children born immediately prior to a static birthdate deadline for establishing age-based cohorts. The RAE has been found across athletic and academic pursuits and is related to depression and suicide rates. We assess RAE for high school swimmers on data collected in Houston. Our results provide a link for establishing a causal relationship between a static deadline for establishing age-based cohorts and the RAE.

■ MC13

Level 2 - Room 202A

Exploring Key Drivers of Innovation at the Level of the Individual, the Organization, and the Crowd

Cluster: New Product Development

Invited Session

Chair: Jeremy Hutchison-Krupat, Assistant Professor, Darden School of Business, University of Virginia, 100 Daredn Blvd, Charlottesville, VA, 22903, United States of America, krupatj@darden.virginia.edu

1 - Risk Taking in Contests

Sanjiv Erat, UCSD, 9500 Gilman Drive #0553, La Jolla, CA, 92093, United States of America, serat@ucsd.edu

Innovation contests, with its competitive winner-take-all incentives, has implications to the "riskiness" of outcomes that would be chosen by the contestants. In the current study, a laboratory experiment is presented, and the results are shown to flatly contradict the key prediction of agent's risk behavior in the canonical contest model. Some plausible modifications of the canonical model are explored to reconcile the data.

2 - Implementing Innovation Strategy: The Effects of Organizational Structure and Project Scope

Jeremy Kovach, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, jeremy.kovach@scheller.gatech.edu, Stylianos Kavadias

During the project definition (scoping) phase of a project, strategic initiatives are translated into executable objectives. We investigate how the organizational structure, project scope, and performance metrics influence the implementation of innovation strategy. We recognize the dual role of performance metrics: they communicate the project scope (what types of project outcomes are sought), and determine the organizational impetus (effort commitment) from the functional stakeholders.

3 - Leaps in Innovation
Joel Wooten, University of South Carolina, Moore School of Business, Columbia, SC, United States of America, joel.wooten@moore.sc.edu

Search for solutions over a landscape of possibilities is central to innovation contests. Here, we look at algorithmic innovation tournaments from Kaggle.com to examine the effect incremental and discontinuous progress has on additional innovation.

4 - Stage Time Reductions in NPD Cycles: Context-Specific Impacts on Market Gains and Strategic Caveats
Raul Chao, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, chaor@darden.virginia.edu, Elliot Bendoly

We empirically investigate how time reductions in particular product development stages impact market value. Using longitudinal project data from 107 firms, we compare stage times prior to and following investments in NPD process changes. Our analysis reveals a predominance of focus on time reduction in the late stages of product development, and the existence of an inverted-U relationship between market performance and time reductions for some stages.

■ MC14

Level 2 - Room 202B

Supply Chain Reliability and Robustness: Models and Methodologies

Cluster: Managing Disruptions in Supply Chain

Invited Session

Chair: Chase Rainwater, University of Arkansas, Bell Engineering Center, Fayetteville, AR, 72701, United States of America, cer@uark.edu

1 - Mixed-Integer Linear Programming Models for Reliable System Design
Kelly Sullivan, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ksulliv@uark.edu

We present an LP for computing the reliability of a broad class of systems consisting of independent components. This model can be extended to address a number of questions arising in reliability. To illustrate this, we extend the reliability-computing LP to derive a mixed integer linear program for the redundancy allocation problem. We present a brief computational study to demonstrate the viability of this approach.

2 - Constraint Programming Approaches for Optimizing Inland Waterway Infrastructure Maintenance
Ridvan Gedik, PhD Candidate, University of Arkansas, 1125 W Maple St., Fayetteville, AR, 72701, United States of America, rgedik@email.uark.edu, Ed Pohl, Kenneth Mitchel, Heather Nachtmann, Chase Rainwater

The U.S. Army Corps of Engineers (USACE) dredges hundreds of navigation projects to make the waterways navigable. The USACE seeks to optimize the decision of allocating dredge resources to navigation projects under necessary system constraints including but not limited to:(i) environmental window restrictions (ii) resource availability, and (iii) varying equipment productivity rates. We discuss modeling aspects of this problem using constraint programming (CP) and logic-based Benders algorithms.

3 - Inventory Management for a Distribution System Subject to Supply Disruptions
Lin He, Ph.D. Candidate, Lehigh University, H.S. Mohler Laboratory, 200 West Packer Ave., Bethlehem, PA, 18015, United States of America, lih308@lehigh.edu, Lawrence V. Snyder

We study inventory optimization for continuous-review multi-echelon distribution systems subject to supply disruptions, with Poisson customer demands under a first-come, first-served allocation policy. We develop a recursive optimization heuristic, which applies a bottom-up approach that sequentially approximates the base-stock levels of all the locations. A preliminary numerical study shows that it performs very well, reaching within 1% of optimal for most instances tested.

■ MC15

Level 2 - Room 203

Case Studies and Methods in Disaster Relief

Sponsor: Service Science

Sponsored Session

Chair: John Coles, Ph.D. Student, University at Buffalo, 306 Sundridge Dr., Buffalo, NY, 14228, United States of America, jbcoles@buffalo.edu

1 - Emergency Resources Allocation for Disaster Response: An Evolutionary Approach
Mohammed Muaafa, PhD Candidate, Stevens Institute of Technology, 4501 Bergenwood Ave., North Bergen, NJ, 07047, United States of America, muaafa@hotmail.com, Jose Emmanuel Ramirez-Marquez, Ana Lisbeth Concho

The high volume of potential casualties and urgency of a fast response increase the complexity of a disaster response mission and the need for developing an effective and efficient disaster response strategy. The research focuses on finding optimal emergency medical response strategies characterized by: locations of temporary emergency units, dispatching strategies of emergency vehicles, and number of victims to be evacuated. The objectives are to minimize response time and cost of the strategy.

2 - The Search for a New Waffle House Principle – A Case Study in Business Operation after Hurricane Sandy
Tom Darlington, University at Buffalo, The State University of New York, 328 Bell Hall, Buffalo, NY, 14228, United States of America, tedarlin@buffalo.edu, John Coles, Jun Zhuang, Matthew Brondum

FEMA currently makes use of WaffleHouse statuses in the southeastern United States to gauge the condition of a region in order to efficiently administer disaster relief. However, the "WaffleHouse Principle" cannot be applied everywhere due to the scarcity of WaffleHouse locations outside of the southeast. In this research we explore whether data from the Hurricane Sandy response about other businesses' status could be used to develop an alternative measure for assessment.

3 - Characteristics and Modeling of Organizational Networks: A Disaster Operations Case Study in the US
John Coles, Ph.D. Student, University at Buffalo, 306 Sundridge Dr., Buffalo, NY, 14228, United States of America, jbcoles@buffalo.edu, Jun Zhuang

After a disaster strikes, the need to provide effective and immediate relief forces a network of partnerships between agencies to develop. In this talk we look at two case studies of interagency partnership after disasters, and compare and contrast network behavior. Using data from interviews about the 2011 tornado in Joplin Missouri and Hurricane Sandy in 2012, we explore how some characteristics of interagency networks might be captured for use in modeling and simulation.

■ MC16

Level 2 - Room 204

Tutorial: Engineering for Efficient, Effective, Equitable Decisions in Public Health

Sponsor: Health Applications

Sponsored Session

Chair: Julie Swann, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, jswann@isye.gatech.edu

1 - Engineering for Efficient, Effective, Equitable Decisions in Public Health
Julie Swann, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, jswann@isye.gatech.edu

Many opportunities exist to engineer more efficient, effective, and equitable decisions in public health, which is the "science and art of preventing disease, prolonging life, and promoting health" within and across populations. We will present examples of work with or for public health collaborators 1) linking disease modeling with decision support 2) administering or distributing vaccines effectively, and 3) connecting health access with outcomes and appropriate interventions. Challenges and strategies for success will be discussed.

■ MC17

Level 2 - Room 205A

Customer Satisfaction

Sponsor: Service Science

Sponsored Session

Chair: Chie-Hyeon Lim, POSTECH, Quality Systems Lab., Dept. of IME, San 31, Hyoja-dong, Nam-gu, Pohang, 790-784, Korea, Republic of, arachon@postech.ac.kr

1 - Non-linear Modeling of Customer Satisfactions

Nobuhiko Terui, Professor, Tohoku University, Kawauchi, Aoba-ku, Sendai, Japan, terui@econ.tohoku.ac.jp, Taemyung Chun, Kosuke Ogawa, Satoshi Shibata

Focusing on nonlinear relationship between customer satisfaction and customer loyalty which has been discussed in the literature, we propose non-linear modeling of customer satisfaction index(CSI). We empirically show that nonlinear model is better than linear model, and non-linear patterns are different across industries according to the competitive environment in a market and consumer's degree of involvement.

2 - Warranty Pricing with Product Failures and Forward Looking Consumers: An Empirical Approach

Jingqi Wang, Northwestern University, 2001 Sheridan Rd., Evanston, IL, 60611, United States of America, jingqi-wang@kellogg.northwestern.edu, Ozge Islegen, Baris Ata

We study warranty pricing for durable goods, considering product failures. Consumers solve a dynamic program to make purchases. We introduce the inclusive value processes to reduce the dimension of the estimation problem. We estimate consumers' preferences using the model and individual level transaction data. By conducting counterfactual experiments, we find that warranties are underpriced. Lastly, we explore the impact of changing product reliability on the retailer's profit.

3 - Customer Experience Board: A Structured Tool for Visualizing Experience-centric Service Processes

Chie-Hyeon Lim, POSTECH, Quality Systems Lab., Dept. of IME, San 31, Hyoja-dong, Nam-gu, Pohang, 790-784, Korea, Republic of, arachon@postech.ac.kr, Kwang-Jae Kim

An experience-centric service (EXS) is a type of service in which customers experience emotionally appealing events and activities resulting in their distinctive memory. Examples include amusement park, entertainment, counseling, party, and leisure services. This talk proposes a structured tool for visualizing customer experience process in EXSs, called Customer Experience Board. Using this tool, users can obtain a systematic understanding of the value-creation mechanism of an EXS.

■ MC18

Level 2 - Room 205B

Service Sourcing

Sponsor: Service Science

Sponsored Session

Chair: Daniel Greenia, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, dangreenia@us.ibm.com

1 - The Strategic Role of Quality Monitoring in the Outsourcing of Service-based Business Processes

Shouqiang Wang, Assistant Professor, Clemson University, 131D Sirrine Hall, Clemson, SC, 29634, United States of America, Shouqiw@clemson.edu, Aleda Roth

We investigate the impact of buyer's commitment to monitoring its service provider's quality in outsourcing. Focusing on the informational role of in-house versus third-party quality monitoring program, we observe trade-offs. Counter to conventional wisdom, the timing of contracting with the third-party also plays a subtle, yet critical role in performance.

2 - A Win Prediction Model for IT Outsourcing

Daniel Greenia, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, dangreenia@us.ibm.com, Mu Qiao, Rama Akkiraju

Our research objective is to discover factors that correlate with winning Information Technology (IT) outsourcing contracts in a competitive setting. By understanding these correlations, an IT service provider can potentially increase the chances of winning a bid by improving the quality of critical situation-dependant factors. Using data from a large IT service provider, we conduct a correlation analysis to select model features, and build a predictive model using the naÔve Bayesian approach.

■ MC19

Level 2 - Room 205C

Healthcare Applications

Sponsor: Applied Probability

Sponsored Session

Chair: Carri Chan, Assistant Professor, Columbia Business School, New York, NY, United States of America, cwchan@columbia.edu

1 - Donor-Dependent Scoring Schemes: Shaping the Allocation of Cadaver Kidneys in a New Era

Yichuan Ding, University of British Columbia, 4735 W 4th Ave., Vancouver, BC, V6T1C3, Canada, Daniel.Ding@sauder.ubc.ca, Stefanos Zenios, Baris Ata

This paper undertakes a modeling based analysis of scoring systems which are used to allocate cadaver kidneys to patients on the waitlist. We use a fluid model to approximate the transplant waitlist, and assume that patients make rational decisions based on the predictions from the fluid model. We show that at the equilibrium state, a donor-dependent ranking system increases the chance of survival-based matching and enables the acceptance of kidneys when compared to a donor-independent system.

2 - A Dynamic Model of Kidney Exchange Programs

Ross Anderson, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, 02139, United States of America, rma350@mit.edu, Yashodhan Kanoria, David Gamarnik, Alvin Roth, Itai Ashlagi

Kidney exchange programs enable patients with living but incompatible donors to exchange kidneys. In practice, exchange programs periodically maximize the number of transplants performed; however, the long run implications of this policy are not well understood. We analyze this issue empirically, using data from a large kidney exchange, and theoretically, with a dynamic random graph model, and find that the greedy policy (reoptimizing at every patient arrival) is as good as any batching policy.

3 - Optimal Control of an Emergency Room Triage and Treatment Process

Gabriel Zayas-Caban, PhD Candidate, Cornell University, Center for Applied Mathematics, Ithaca, NY, 14853, United States of America, gz63@cornell.edu, Mark Lewis, Jingui Xie, Linda Green

Patient care in many healthcare systems consists of two phases of service; assessment, or triage, and treatment. It is often the case that these phases are carried out by the same medical provider. We consider the question of how to prioritize the work by the provider to balance initial delays for care with the need to discharge patients in a timely fashion. We present a single server two-stage tandem queueing model for the emergency room triage and treatment process.

4 - Step-down Units vs. Intensive Care Units

Carri Chan, Assistant Professor, Columbia Business School, New York, NY, United States of America, cwchan@columbia.edu, Mor Armony, Bo Zhu

Step Down Units (SDUs) provide an intermediate level of care between the intensive care unit (ICU) and the general medical-surgical wards. We consider how the relative sizes of these units impact patient flows and examine how to optimally allocate nursing staff across the units. Our work provides guidance into the management of two hospital units reserved for the hospital's sickest patients and provides insight into the tradeoff between flexibility and increased resources which arises.

■ MC20

Level 2 - Room 205D

Control of Queueing Systems

Sponsor: Applied Probability

Sponsored Session

Chair: Cathy Xia, Associate Professor, Ohio State University, Columbus, OH, United States of America, xia.52@osu.edu

1 - Partial Flexibility in Routing and Scheduling

Rhonda Righter, Professor, University of California-Berkeley, IEOR Dept., Berkeley, CA, 94720, United States of America, rrighter@ieor.berkeley.edu, Osman Akgun, Ronald Wolff

Some customers are dedicated to a specific server and some are flexible. We give conditions for the optimality of Dedicated Customers First (DCF) for scheduling, and Join the Smallest Work (JSW) or Join the Shortest Queue (JSQ) for routing of flexible customers. We compare these policies in terms of both efficiency and fairness, and argue that the overall best approach for call centers is JSW routing. We show how this can be implemented in call centers even when work is unknown.

2 - In-network Function Computation: Spanning Trees and Multi-class Fork-join Queues
Samyukta Sethuraman, Texas A&M University, 3131 TAMU, College Station, TX, United States of America, samyukta@tamu.edu, Natarajan Gautam

We consider a sensor network where nodes simultaneously measure events and transmit to a sink. However, the sink node is ultimately interested in a function of the measured values, such as maximum, minimum, etc. To efficiently perform this under stochastic conditions, we seek a set of spanning trees to route the sensed information. We model the flow of information as a fork-join queueing network. We obtain bounds on the performance, and thereby select ideal set of spanning trees.

3 - Decentralized Inventory Rebalancing for Large-scale Vehicle Sharing Systems
David George, Monsanto Company, St. Louis, MO, United States of America, david.k.george@monsanto.com, Cathy Xia

We study the joint control problem of dynamic vehicle repositioning and customer admission in a general vehicle sharing system. We present a decentralized approach, based on a closed queueing network model, that is able to be efficiently implemented in an agent-based manner with low-complexity computations. We provide an analysis of our algorithm's long-run performance, along with simulations.

4 - Optimal Stock Allocation for Production-Inventory Systems with Multiple Impatient Customer Classes
Yasar Levent Kocaga, Assistant Professor, Sy Syms School of Business, Yeshiva University, 2495 Amsterdam Avenue, New York, NY, 10033, United States of America, kocaga@yu.edu, Yen-Ming Lee

We address the production and inventory control of a make-to-stock system that serves multiple impatient customer classes. We assume Poisson arrivals and an exponential production time. Orders that are not satisfied immediately wait up to an exponentially distributed amount of time and abandon the system if not satisfied within this time. We show that the threshold inventory rationing policy is still optimal under certain conditions including a requirement on the order of abandonment rates.

■ MC21

Level 2 - Room 206

Analytical Approaches for Improving Healthcare Operations

Sponsor: Health Applications

Sponsored Session

Chair: Yann Ferrand, Clemson University, Clemson, SC, United States of America, yferran@clemson.edu

Co-Chair: Muer Yang, Assistant Professor, University of St. Thomas, 1000 LaSalle Avenue, SCH 435, Minneapolis, MN, 55403, United States of America, yangmuer@stthomas.edu

1 - The Impact of Demand Variability in a Centralized Healthcare Supply Chain
Claudia Rosales, Assistant Professor, Michigan State University, 350 North Business Complex, East Lansing, Mi, 48824, United States of America, rosales@bus.msu.edu

Large healthcare systems usually consolidate the purchasing, storage, and delivery of all medical supplies in one centralized department achieving economies of scale. Nevertheless the efficiency of a centralized distribution system can be affected by factors such as seasonal consumption patterns. We study the impact of demand seasonality in a centralized healthcare supply chain and provide decision support systems to reduce its impact on customer service level, inventory, and operating costs.

2 - Effectiveness of Utilizing Expected Mortality Information in Attestation Note
Nuo Xu, Univ of Alabama at Birmingham, 1150 10th avenue south, Birmingham, United States of America, nuoxu@uab.edu

A pilot study of presenting expected mortality information for patients in attestation template started from November 2012, in which one group of attending physicians used the attestation notes while the other did not. The paper looks at the collected data to evaluate the effectiveness of utilizing such information in improving the quality of care.

3 - The ICU Will See You Now: Efficient-Equitable Admission Policies
Muer Yang, Assistant Professor, University of St. Thomas, 1000 LaSalle Avenue, SCH 435, Minneapolis, MN, 55403, United States of America, yangmuer@stthomas.edu, Michael Fry, Corey Scurlock

Intensive care units (ICU) are frequently the bottleneck in a hospital system. We examine admission policies for a surgical ICU where patients arrive in batches, with the objective of balancing system efficiency and equity. We propose a simple and efficient heuristic solution method that provides a performance guarantee. We also apply our admissions policy to a real cardiothoracic-surgical ICU setting.

4 - Dynamic Prioritization for Emergency Physicians
Yann Ferrand, Clemson University, Clemson, SC, United States of America, yferran@clemson.edu, Todd Glass, Michael Magazine, Uday Rao

To improve patient flow in an emergency department, we augment current prioritization practices with a consideration of actual time spent in the system. We use discrete event simulation to measure the performance of these new prioritization rules on both the average and on various percentiles of patient wait time, and compare them to the current practice at a specific emergency department.

■ MC22

Level 2 - Room 207

George B. Dantzig Dissertation Prize I

Cluster: George B. Dantzig Dissertation Award

Invited Session

Chair: Zeynep Aksin Karaesmen, Professor, Koc University, Rumeli Feneri Yolu Sariyer, Istanbul, 34450, Turkey, zaksin@ku.edu.tr

1 - George B. Dantzig Dissertation Prize
Zeynep Aksin Karaesmen, Professor, Koç University, Rumeli Feneri Yolu Sariyer, Istanbul, 34450, Turkey, zaksin@ku.edu.tr

The George B. Dantzig Disseration Award recognizes dissertations that are relevant to the practice of operations research and the management sciences. The award is designed to support greater interaction between academia and the world of practice by awarding research that combines development of novel methodology and new techniques with creative application in a practical real-world setting. Problem scope and potential magnitude of impact of research are considered. In this session, the award finalists will present their research.

■ MC23

Level 2 - Room 208A

Practical Aspects of Revenue Management and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Maarten Oosten, SAS Institute Inc., SAS Campus Drive, Cary, NC, 27513, United States of America, Maarten.Oosten@sas.com

1 - RM in the Car Rental Industry
Chi Ip, Enterprise Holdings, St., Louis, United States of America, Chi.M.Ip@ehi.com

In this presentation we will discuss some practical aspects related to revenue management in the car rental industries. This includes topics like brand management, planning capacity, and strategically valuing the customers.

2 - The Value of the Price Envelope
Bahadir Aral, SAS Institute, SAS Campus Drive, Cary, NC, 27511, United States of America, Bahadir.Aral@sas.com

In Business-to-Business pricing (B2B pricing) the price recommendation is often provided in the form of a price envelope. This is a series of reference points that supports the seller in negotiating the price. Examples of such reference points are the triple of a starting price, a target price, and a floor price. There are some practical and intuitive reasons for this approach, but in this paper we show the value by means of a simulation.

3 - Revenue Management as a Strategic Tool
Maarten Oosten, SAS Institute Inc., SAS Campus Drive, Cary, NC, 27513, United States of America, Maarten.Oosten@sas.com

There are many examples where having a revenue management system has proven to be a strategic advantage. However, revenue management also makes it possible to translate strategic decisions into operational pricing decisions. Today we will discuss some options.

■ MC24

Level 2 - Room 208B

Retail Operations

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Xuying Zhao, University of Notre Dame, Mendoza College of Business, Notre Dame, United States of America, Xuying.Zhao.29@nd.edu

1 - The Impact of Consumer Returns on a Manufacturing Multichannel Strategy

Paolo Letizia, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, letizia@rsm.nl, Terry Harrison

Products sold over Internet, thanks to product variety and customization, can offer higher marginal value to the consumers than the ones sold at the store. However, there might be uncertainty about product fit. The manufacturer has to strategically control, through prices and a returns policy, the flow of consumers buying his products through the on-line channel vs. the retail channel.

2 - Quality and Pricing Decisions when Consumers Perceive Recycled Content Differently

Tolga Aydinliyim, Assistant Professor, Baruch College, Zicklin School of Business, New York, NY, United States of America, tolga@uoregon.edu, Monire Jalili, Nagesh Murthy

We consider a monopolist selling ordinary and green product variants to consumers whose differential (dis)utility vary by consumer type, and is a function of the firm's quality decision (i.e., the amount of recycled content.) We discuss how the optimal quality and pricing decisions drive demand and profit.

3 - Dynamic Pricing or Dynamic Logistics?

Thunyarat Amornpetchkul, University of Michigan, 701 Tappan Ave., Ann Arbor, MI, 48104, United States of America, thunyara@umich.edu, Hyun-Soo Ahn, Ozge Sahin

Retailers who sell their products through multiple channels often hold inventory at separate locations, dedicated for demand arriving at each channel. When inventory level does not match with demand, transshipment across channels may be beneficial. We characterize and compare the effectiveness of the retailer's optimal pricing and transshipment policy. Furthermore, we investigate how the optimal pricing policy is affected by the transshipment policy, and vice versa.

4 - When Does Advance Selling Benefit Manufacturers, Retailers, or Both?

Xuying Zhao, University of Notre Dame, 361 Mendoza College of Business, Notre Dame, IN, 46545, United States of America, xzhao1@nd.edu, Zhan Pang, Kathryn Stecke

We consider a supply chain with a retailer who has advance selling capability. We show having the capability of advance selling can hurt the retailer's profit, the supply chain profit, and social welfare, while always benefits the manufacturer.

5 - Dynamic Supply Risk Management under Information Asymmetry

Long Gao, Assistant Professor, UC Riverside, 221 AGSM, UCR, Riverside, United States of America, long.gao@ucr.edu, Nan Yang

We study a dynamic supply risk management problem in a decentralized supply chain. The problem features private supply risk information and incentives for information misreporting and underinvestment in quality. Our study shows how to motivate the supplier to truthfully share the supply state and invest in quality improvement, as well as when to terminate the relationship.

■ MC25

Level 2 - Room 208C

Strategy-Proofness

Cluster: Auctions

Invited Session

Chair: Ben Lubin, Boston University, Boston, MA, United States of America, blubin@bu.edu

1 - Average-case Analysis of VCG with Resource Allocation Algorithms

Yevgeniy Vorobeychik, Vanderbilt University, 2201 West End Ave., Nashville, TN, United States of America, eug.vorobey@gmail.com

We present a framework for establishing an empirical bound on incentives to lie in VCG using approximate resource allocation algorithms. We apply this framework on combinatorial auction data generated by CATS. Our analysis demonstrates that, contrary to past theoretical results, using state-of-the-art algorithms for solving combinatorial allocation problems results in essentially no incentives to misreport preferences.

2 - Approximate Incentive Compatibility via Fixed-point Payment Rules

Ben Lubin, Boston University, Boston, MA, United States of America, blubin@bu.edu

In settings where incentive compatibility is not achievable (e.g. budget-balanced combinatorial exchanges) we seek a payment rule with minimal incentive to misreport in Bayes-Nash equilibrium. We model this problem as a multi-player game that includes the center, whose strategy controls the imposed payment rule. Focusing solely on the profit available from trade, we find an approximate fixed point numerically by a variational formulation, and characterize these payment rules in several settings.

3 - Strategy-proofness, Investment Efficiency, and Marginal Returns: An Equivalence

John Hatfield, Stanford University, Stanford Graduate School of Business, Stanford, CA, United States of America, hatfield_john@gsb.stanford.edu, Fuhito Kojima, Scott Kominers

Suppose agents make pre-market investment choices before participating in a centralized market mechanism. We show that a mechanism in this setting induces agent i to make efficient investment choices if and only if that mechanism also rewards agent i with his marginal surplus. For an efficient mechanism, this is equivalent to strategy-proofness for i. We show that workers are incentivized to make efficient human capital investments before entering the labor market, eliminating hold-up problems.

■ MC26

Level 2 - Room 208D

Location Problems under Uncertainty

Sponsor: Location Analysis

Sponsored Session

Chair: Stefan Nickel, Karlsruhe Institute of Technology, PO Box 3640, Karlsruhe, 76021, Germany, stefan.nickel@kit.edu

1 - Hub Location under Uncertainty

Stefan Nickel, Karlsruhe Institute of Technology, PO Box 3640, Karlsruhe, 76021, Germany, stefan.nickel@kit.edu, Sibel Alumur, Francisco Saldanha-da-Gama

In this talk, we address several aspects concerning hub location problems under uncertainty. Two sources of uncertainty are considered: the set-up costs for the hubs and the demands to be transported between the nodes. Firstly, the two sources of uncertainty are analyzed separately and afterwards a more comprehensive model is proposed considering all sources of uncertainty. Computational tests show the changes in the solutions driven by the different sources of uncertainty considered.

2 - Competitive Facility Location and Design Problem: Identifying Optimal Designs

Robert Aboolian, California State San Marcos, San Marcos, CA, United States of America, raboolia@csusm.edu, Dmitry Krass, Oded Berman

In this paper we develop a novel methodology to simultaneously optimize locations and designs for a set of new facilities facing competition from some pre-existing fa- cilities. Known as the Competitive Facility Location and Design Problem (CFDLP), this model was previously only solvable when a limited number of design scenarios was pre-specied. Our methodology removes this limitation and allows for solving of much more realistic models. The results are illustrated with a small case study.

3 - The Unreliable Capacitated Facility Location Problem : Submodularity and Bounding Techniques

Serigne Gueye, Assistant Professor, Université d'Avignon LIA-CERI, 339, Chemin des Meinajaries, Agroparc BP 91228, Avignon, 84911, France, serigne.gueye@univ-avignon.fr, Mozart Menezes

The Unreliable Capacitated Facility Location Problem consists in locating facilities, with random capacities (correlated or not), to customers, in such a way to maximize the expected profit. The problem is expressed as a 2-stage stochastic program. We show that the expected profit function is always submodular, and monotone in the particular case of zero fixed cost. Upper and lower bounding techniques are proposed on randomly generated instances.

■ MC27

Level 2 - Room 209A

Operations Research and Mathematical Modeling in Military Decision Making

Sponsor: Military Applications

Sponsored Session

Chair: William Fox, Naval Postgraduate School, 589 Dyer Road, Room 214, Monterey, CA, 93943, United States of America, wpfox@nps.edu

1 - How to (Can You?) Influence a Population's Attitude with a Single Whisper

Robert Burks, Naval Postgraduate School, 5125 Ocean Bluff Blvd, Seaside, United States of America, reburks@nps.edu

Rumor propagation in complex societal networks is studied through a Social Contagion model and Agent Based Simulation to identify key individuals in a network to target with dis-information, ensuring that the dissemination of information reaches the largest possible individuals and triggers an information cascade. This talk provides a modeling framework identifying individuals that are good early adopters who are most effective in supporting the spread of information through the population.

2 - Multi-attribute Methods in Key Node Analysis using SNA metrics

William Fox, Naval Postgraduate School, 589 Dyer Road, Room 214, Monterey, CA, 93943, United States of America, wpfox@nps.edu

We use data envelopment analysis, analytical hierarchy process, and TOPSIS as methods to identify key nodes in a social network across all metrics. We illustrate our results using two common networks from the literature. We discuss some basic sensitivity analysis can may be applied to the methods. We find the TOPSIS method as the most flexible method to weight the criterion based upon the decision makers' inputs or the topology of the network.

3 - Using Operations Research and Networks to Generate Scenarios and Analyze Wargames

David Arney, United States Military Academy, Department of Mathematics, West Point, United States of America, david.arney@usma.edu, Kira Hutchinson

Scenario generation and war-gaming must incorporate the complexities of the real world. Rare event modeling is based on impactful real events that result in state changes. Our framework generates scenarios for DoD planning. Our template-, network- and measure-based methodology takes into account military concepts that integrate perspectives, network database structures, and informative measures of significance. This system provides a basis for force planning and technology decisions.

4 - A Maximum Expected Covering Problem for Locating and Dispatching Two Types of MEDEVAC assets

Ben Grannan, Virginia Commonwealth University, 1015 Floyd Ave., Richmond, Va, United States of America, grannanbc@vcu.edu, Nathaniel D. Bastian, Laura McLay

Military emergency medical systems save lives by responding to casualty events and evacuating high-risk casualties to a medical treatment facility with air and ground MEDEVAC assets. We propose a novel MIP model to optimally locate air and ground MEDEVAC assets and assign the assets to casualty events. The objective is to maximize the proportion of high-priority casualties responded to within the Golden Hour. Hypercube correction factors remove the assumption of asset independence.

■ MC28

Level 2 - Room 209B

Theory and International Applications II

Cluster: Data Envelopment Analysis

Invited Session

Chair: Timo Kuosmanen, Professor, Aalto University School of Business, Helsinki, Finland, timo.kuosmanen@aalto.fi

1 - Modeling Multiple Outputs and Joint Production in Stochastic Semi-nonparametric Envelopment of Data

Timo Kuosmanen, Professor, Aalto University School of Business, Helsinki, Finland, timo.kuosmanen@aalto.fi, Andrew Johnson

Stochastic semi-nonparametric envelopment of data (StoNED) is a new frontier estimation method that combines an axiomatic DEA-style piece-wise linear frontier with probabilistic SFA-style treatment of inefficiency and noise. This paper employs directional distance functions to extend the StoNED method to the general multiple input multiple output settings. We apply the multi-output StoNED method to efficiency assessment of electricity distribution networks in Finland.

2 - Aggregation of Activities and Inputs in Data Envelopment Analysis

Endre Bjørndal, Associate Professor, NHH Norwegian School of Economics, Helleveien 30, Bergen, 5045, Norway, endre.bjorndal@nhh.no, Mette Bj˜rndal

We study the misspecification bias that arises from using a single DEA-model to evaluate activities that are in fact separable. The bias can be attributed to activity aggregation and input aggregation, respectively. The former effect is non-negative, whereas the latter, known in the literature as intra-input aggregation, is non-positive in the absence of allocative inefficiency. We demonstrate, using simulated data, the total effect of model misspecification on technical and cost efficiency.

3 - Energy Efficiency in India's Energy Intensive Industries: A Directional Distance Function Analysis

Kankana Mukherjee, Associate Professor, Babson College, Economics Division, 231 Forest Street, Babson Park, MA, 02457, United States of America, kmukherjee@babson.edu

This study utilizes the method of Data Envelopment Analysis and directional distance function to examine the energy efficiency of each of the energy intensive industries across the states in India over the period 2004-05 to 2007-08. Results show that significant potential for simultaneous increase in output and reduction in energy use exists, particularly for the paper and paper products industry and for the chemicals and chemical products industry.

■ MC29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - LINDO Systems, Inc. - Optimization Made Easy

Mark Wiley, LINDO Systems, Inc., 1415 North Dayton St., Chicago, IL, 60642, United States of America, mwiley@lindo.com, Gautier Laude

Learn to quickly build linear, nonlinear, global and integer optimization models; incorporate uncertainty into models; access data in Excel / databases; and create custom optimization applications. See the newest releases of: LINDO API - callable solver engine; LINGO - integrated modeling language and solvers; and What'sBest! - large-scale solver for Excel.

2 - AMPL Optimization, Inc. - New AMPL Interfaces for Enhanced Development and Deployment of Optimization Models

Robert Fourer, President, AMPL Optimization Inc, 900 Sierra Pl. SE, Albuquerque, NM, 87108, United States of America, 4er@ampl.com

We introduce the new AMPL IDE, which provides an integrated command interpreter and file editor for more convenient optimization model development. Additionally we present details of the first AMPL APIs, which facilitate model deployment by letting your applications invoke many AMPL functions directly, using calls written in popular programming languages.

■ MC30

Level 2 - Room 210B

Industrial Applications for Optimization Methodologies

Contributed Session

Chair: Jonathon Leverenz, Clemson University, Clemson University, Clemson, SC, 29634, United States of America, jlevere@clemson.edu

1 - Excitement of Exploration Drives from Premature Toward Geometric Convergence

Yingjie Lan, Dr, Peking University, Beijing University, Beijing, 100871, China, 0006174372@pku.edu.cn

By encouraging exploration upon good moves, a new optimization-by-simulation method is proposed to not only avoid premature but exhibit geometric convergence. Computational experiments are carried out to illustrate its convergence behavior in the multivariate case and to compare its performance with the cross-entropy method.

2 - Embedding Wireless Strain Sensors in Hip Implants
Arun Krishnasamy, Student, University of Oklahoma, 1119 East Brooks St., Norman, Ok, 73071, United States of America, arunkishorek29@ou.edu

The objective is to implant wireless self-powering piezoelectric strain sensor in a bio medical hip implant.This proposed system is a combination of Microelectro mechanical system and piezoelectric generator,which is capable of converting mechanical pressure into electrical signals.The piezoelectric sensor is integrated with hip implants due to their capability to generate power.So an active monitoring system which can communicate the changes in the implant is necessary for sustaining it's life.

3 - Sequencing Heterogeneous Punctual Patients
Ahmad Reza Pourghaderi, PhD Student, National University of Singapore, 1 Engineering Drive 2, E1A-06-25, Singapore, 117576, Singapore, pourghaderi@nus.edu.sg, Boray Huang

The problem of appointment sequencing for patients with different service requirements is considered. The objective is to minimize the total expected waiting time. We challenge the widely accepted conjecture that the optimal sequence is the ascending order of service time variances. A sufficient condition to ensure the smaller variance first rule is not optimal for 4-patient problem is derived as well as some interesting properties of the waiting time of the nth arrival in different sequences.

4 - Network Target Coordination for Complex (Engineered) Systems
Jonathon Leverenz, Clemson University, Clemson University, Clemson, SC, 29634, United States of America, jlevere@clemson.edu

Complex engineered systems are inherently coupled and difficult to model. Network Target Coordination is an optimization methodology capable of decomposing a complex system into a network of interacting optimization problems. A modeling process is presented as well as a solution algorithm capable of determining an optimal solution to the overall system.

5 - Optimization of a Centrifugal Electrospinning Process: A Blended DOE, RSM and ANN Approach
William Duff, Professor, Colorado State University, Dept. of Mechanical Engineering, Ft. Collins, CO, 80523, United States of America, bill@engr.colostate.edu, John Labadie, Frank Greenawalt

Centrifugal electrospinning (CE) is a promising new method that can potentially produce nano-fibers 500 times faster than existing methods. Different problems associated with CE fiber morphology need to be controlled to produce quality filtration media. A production prototype is being used to study the process. Eight factors have been established as being potentially important. DOE, RSM, and ANN methods are being used to determine desired operating ranges for the process.

■ MC31

Level 2 - Room 211A

Careers in Industry

Sponsor: Women in OR/MS

Sponsored Session

Chair: Erica Klampfl, Technical Leader, Ford Motor Company, 2101 Village Road, Dearborn, MI, United States of America, eklampfl@ford.com

1 - Boeing Operations Research Project Examples
Sharon Arroyo, The Boeing Company, PO Box 3707, MC 42-58, Seattle, WA, 98124, United States of America, sharon.f.arroyo@boeing.com

The Operations Research Group at Boeing partners with organizations across the company to improve results by applying operations research expertise to business opportunities. The group is engaged in improving processes in areas including supply chain, transportation, production, and communications systems. Insights into how the group collaborates and specific project examples will be given in this presentation.

2 - Oil and Gas Industry: Career Opportunities in Optimization, Logistics and Data Analysis
Cassandra McZeal, Senior Staff Mathematician, ExxonMobil, PO Box 2189, URC-URC-C307, Houston, TX, 77252-2189, United States of America, cassandra.m.mczeal@exxonmobil.com

The increasing complexity of finding, developing, and managing energy sources brings many opportunities for innovation in the areas of optimization, logistics and data analysis. In this talk I will cover several challenges facing the industry and focus on a few example to demonstrate the need for professionals in multiple disciplines from optimization to data analysis.

3 - Career Building at the National Laboratories
Genetha Gray, Sandia National Laboratories, PO Box 969, MS 9159, Livermore, CA, 94551-0969, United States of America, gagray@sandia.gov

In this talk, I will discuss the basic job duties of an operations research or analytics specialist at the national laboratories. I will give examples from my own ten year career as well as examples from co-workers and peers. In addition, I will describe how to use a job at a national laboratory to either build a lifelong career at the lab or to prepare for a career industry.

■ MC32

Level 2 - Room 211B

Innovation in Product, Service and Process Systems

Sponsor: Technology Management

Sponsored Session

Chair: Juliana Hsuan, Professor, Copenhagen Business School, Department of Operations Management, Solbjer Plads 3, Frederiksberg, DK-2000, Denmark, jh.om@cbs.dk

1 - An Analysis of Coffee Brands
Eric Bentzen, Associate Professor, Copenhagen Business School, Department of Operations Management, Solbjerg Plads 3, Frederiksberg, DK-2000, Denmark, eb.om@cbs.dk

In this paper we take a closer look at an expansion of the market share model to separate between competitors and use cross-elasticities to model the interaction between coffee prices and quantity sold and add the effect from events. We use the multiplicative competitive-interaction model as proposed by Cooper (1993) to model the market share of coffee brands.

2 - Network Analysis of Bibliographic Data from the Literature on Modularity
Thomas Frandsen, Assistant Professor, Copenhagen Business School, Department of Operations Management, Solbjerg Plads 3, Frederiksberg, DK-2000, Denmark, tfr.om@cbs.dk

This paper applies network analytical techniques to citation data from the literature on modularity in the fields of management and engineering. This methodology for studying citation structure enables the identification of distinct areas of research on modularity as well as intellectual positions on which the literature is based. The analysis advances our understanding of the literature on modularity by systematically identifying its intellectual structure and evolution.

3 - Innovation Differences between New Venture Startups and Incumbent Firms
Jianxi Luo, Assistant Professor, Singapore University of Techonology & Design, Engineering Product Development, 20 Dover Drive, Singapore, 138682, Singapore, luo@sutd.edu.sg, Katja Otto, Kevin Otto

To understand how innovations from new ventures and incumbents may differ, we compare a sample of 92 award-winning innovations from either new venture or incumbent firms, with respect to product-level characteristics in functionality, architecture, cost, external and user interactions. Results show new venture products hit more innovation characteristic categories than those from incumbents. New ventures also exhibit higher rates of innovation than incumbents in each of the five categories.

4 - Corporate Travel Services: A Triadic and Modularity Perspectives
Anu Bask, Postdocoral Researcher, Aalto University, Runeberginkatu 22-24, Helsinki, 00100, Finland, anu.bask@aalto.fi, Anne-Maria Holma, Antti Laakso, Dan Andersson

In this study we take the buyer's perspective and explore how modularity and service triads are used in service development in indirect sourcing context. We provide a case study where the focal service triad consists of a buyer, technology provider and travel management company. To increase understanding of modular service supply chain networks, we develop a framework for modular service architecture. As methodology we apply longitudinal case study and insider action research.

■ MC33

Level 2 - Room 211C

National University Rail Center (NURail) Systems Research

Sponsor: Railway Applications

Sponsored Session

Chair: Rapik Saat, Research Assistant Professor, University of Illinois at Urbana-Champaign, 205 N Mathews, Urbana, IL, 61822, United States of America, mohdsaat@illinois.edu

1 - Optimization of Rail Defect Inspection Frequency

Tyler Dick, University of Illinois at Urbana-Champaign, 205 N Mathews Ave., Urbana, IL, 61801, United States of America, ctdick@illinois.edu, Xiang Liu, Rapik Saat, Alexander Lovett, Christopher Barkan

Broken rails are among the most frequent causes of freight-train derailments on U.S. railroads. A model is developed to address the trade-offs among various factors related to rail defect inspection frequency, in order to maximize rail transportation safety and efficiency. The model can be used to determine the optimal frequency of rail defect inspection and it provides a tool to aid development of a better-informed train derailment prevention policy.

2 - Accident Analysis of Passenger Trains on Freight Rail Corridors

Chen-Yu Lin, Research Assistant, University of Illinois at Urbana-Champaign, Rm B-118, 205 N. Mathews Ave., Urbana, IL, 61801, United States of America, clin69@illinois.edu

Quantitative understanding of train accidents on shared passenger and freight rail corridors is critical for rational allocation of resources to reduce railroad passenger train risk. Train accident data from the Federal Railroad Administration database are being analyzed to examine the effects of different accident causes. The results can be applied to identify major train accident causes on shared rail corridors, enabling better-informed risk management on shared rail corridors.

3 - Incremental Capacity of Single to Double Track with Variable and Sparse Siding Spacing

Ivan Atanassov, Graduate Research Assistant, University of Illinois RailTEC, B118 Newmark Lab, 205 N Mathews Ave., Urbana, IL, 61801, United States of America, atanass1@illinois.edu, Tyler Dick, Mei-Cheng Shih

This work examines the incremental capacity benefit of adding double track segments to single-track lines with sparse sidings and with variable siding spacing. The work also examines differnt strategies for allocating the double-track resource across a railway subdivision. These results will facilitate the development of an optimal incremental upgrade model for capacity expansion.

4 - Train Scheduling on a Shared Passenger and Freight Corridor with Demand Considerations

Bo Zou, Assistant Professor, University of Illinois at Chicago, 842 west taylor street, 2073 ERF, Dept of civil and materials engineering, Chicago, IL, 60607, United States of America, bzou@uic.edu, Ahmadreza Talebian

This study proposes an integrated, hypergraph-based approach that considers constraints from infrastructure supply as well as passenger and freight demand in solving the train scheduling problem on a shared rail corridor. Different from previous studies, we explicitly examine the impact on the system demand of various scheduling factors, and the extent to which the absence of demand-side consideration could lead to suboptimal results in train planning.

5 - Review of Applying Hybrid Approach of Capacity Simulation on a Shared-use Rail Corridor

Hamed Pouryousef, Graduate Research Assistant, Michigan Technological University, 824 Dow, CEE Dept, 1400 Townsend Drive, Houghton, MI, 49931, United States of America, hpouryou@mtu.edu, Pasi Lautala

There are several simulation tools available for analyzing rail capacity utilization. This research uses two common simulation tools developed in the U.S. and Europe, Rail Traffic Controller (RTC), and RailSys respectively, on a single shared corridor. It evaluates the potential operational benefits of a hybrid approach where output from one software (RTC) is used as input for optimization at another (RailSys) and then brought back to RTC for validation.

■ MC34

Level 2 - Room 211D

Financial Services Section Student Paper Competition

Sponsor: Financial Services

Sponsored Session

Chair: Jim Bander, National Manager, Toyota Financial Services, Toyota Financial Services, Chandler, AZ, 85226, United States of America, jim.bander@gmail.com

1 - Optimal Portfolio Liquidation: Effects of Price Impact, Correlation, Risk Measure and Jumps

Jingnan Chen, University of Illinois at Urbana-Champaign, Champaign, IL, United States of America, jchen98@illinois.edu, Liming Feng, Jiming Peng

This paper considers the optimal portfolio liquidation problem where the objective is to minimize trading cost and risk when financial portfolios are liquidated over a short period of time. We propose Markov chain approximation approaches for computing the optimal trading strategies numerically and for studying analytical properties of such strategies.

2 - On the Inadequacy of Var-based Risk Management: VaR, CVaR, and Nonlinear Interactions

Uma Ravat, University of Illinois at Urbana–Champaign, Department of Mathematics, Urbana, IL, United States of America, ravat1@illinois.edu, Uday Shanbhag, Richard Sowers

Abstract not available.

3 - An Efficiency-based Approach to Stock Selection

Irene Song, Columbia University, Columbia University, 120th Street, New York, NY, 10027, United States of America, is2306@columbia.edu, Soulaymane Kachani, Iraj Kani

This study investigates the relationship between firm efficiency and stock performance by building an efficiency-based investment strategy and assessing its performance over time. Our empirical findings demonstrate the existence of a significant positive relationship between the two and furnish an economic explanation for the relative outperformance of the efficient firms.

4 - Robust Dependence Modeling for High-dimensional Covariance Matrices

Zhe (David) Zhu, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, United States of America, zhe.zhu@sloan.mit.edu, Roy Welsch

Abstract not available.

5 - Robustness to Dependency in Portfolio Optimization using Overlapping Martingales

Xiaobo Li, University of Minnesota, Minneapolis, MN, United States of America, lixx3195@umn.edu, Karthik Natarajan, Vinh Xuan Doan

Abstract not available.

■ MC35

Level 2 - Room 212A

eServices

Sponsor: E-Business

Sponsored Session

Chair: Atanu Lahiri, Assistant Professor, University of Washington, Box 353226, Foster School of Business, Seattle, WA, 98195, United States of America, lahiria@u.washington.edu

1 - Multi-resource Allocation and Pricing in the Cloud

Soumya Sen, University of Minnesota, C319E, EQuad, Olden Street, Princeton, NJ, 08544, United States of America, soumya.sen@datami.com, Carlee Joe-Wong

We discuss the issues of pricing and fair allocation of multiple datacenter resources among heterogenous clients by introducing an analytical framework and empirical studies on workload traces form a Google cluster.

2 - How to Fight Piracy: Differences between Making Pirated Products Less Available vs Less Attractive

Antino Kim, PhD Student, University of Washington, Box 353200, MKZ 360, Seattle, WA, 98133, United States of America, kheehyon@uw.edu

In light of the recent movements towards prosecuting online suppliers of pirated digital goods, we study the effect of such policies and make comparison to the ones that penalize the consumption of illegal copies.

3 - The Zero-day DLC Strategy: A Case for Versioning to Facilitate Product Sampling

Atanu Lahiri, Assistant Professor, University of Washington, Box 353226, Foster School of Business, Seattle, WA, 98195, United States of America, lahiria@u.washington.edu, Debabrata Dey

Out of the recent popularity of downloadable contents (DLC) among video game manufacturers has resurfaced the issue of versioning of information goods. The central idea behind the zero-day DLC strategy is that consumers who find the base version of a game to be sufficiently attractive would pay a premium to upgrade by purchasing such a DLC. We demonstrate that a manufacturer's desire to vertically differentiate this way could actually stem from a horizontal separation among consumers.

■ MC36

Level 2 - Room 212B

Joint Session SPPSN/HAS: Global Health Supply Chains

Sponsor: Public Programs, Service and Needs & Healthcare

Sponsored Session

Chair: Natalie Privett, Assistant Professor of Management and Policy, New York University, Wagner Graduate School of Public Service, 295 Lafayette St., 2nd Floor, New York, NY, 10012, United States of America, natalie.privett@nyu.edu

1 - Analysis of the Procurement and Pricing Architecture for New Vaccines

Natalie Privett, Assistant Professor of Management and Policy, New York University, Wagner Graduate School of Public Service, 295 Lafayette St., 2nd Floor, New York, NY, 10012, United States of America, natalie.privett@nyu.edu, Prashant Yadav

A well designed vaccine procurement and pricing architecture can ensure more equitable prices and greater access. This research compares the pricing and welfare effects of different pooled procurement structures for new vaccines. Analysis reveals that homogenous income pools are beneficial to low income countries, manufacturers, and welfare. However, when heterogeneous, pool composition affects the benefits of pooled procurement and could even disadvantage certain member countries.

2 - Analysis of an Artemisia-based Malaria Medicine Supply Chain

Scott Webster, Syracuse University, Whitman School of Management, 721 University Ave., Syracuse, NY, 13244, United States of America, stwebste@syr.edu, Burak Kazaz, Prashant Yadav

Artemisinin Combination Therapy (ACT), the most effective malaria treatment today is manufactured from an agriculturally derived starting material, Artemisia annua. We present a model of the supply chain that captures the effects of such factors as available farm space, manufacturer capacity, farmer's self-interest, volatility in crop yield, and volatility in the malaria medicine market on such measures as the level and volatility of medicine price and supply.

3 - Dynamic Multi-product Procurement for Global Health

Iva Rashkova, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, irashkova.phd2009@london.edu, Jérémie Gallien

Motivated by the funding of pharmaceutical procurement programs by the Global Fund, we study the problem of periodic inventory ordering for multiple products subject to a common exogenous disbursement schedule. We minimize expected weighted stockout levels in the presence of random demand and procurement lead times; unmet demand is partially backordered to capture situations ranging from lost sales to full backordering. We derive near-optimal heuristics and discuss related managerial insights.

4 - Human Capacity Building in LMIC

Yehuda Bassok, Professor, University of Southern California, Marshall School of Business, Los Angeles, CA, 90089, United States of America, bassok@marshall.usc.edu, Sriram Dasu

We will present our experiences in building human capacity for managing health care delivery systems mainly in Cameroon. We work with local universities to train their student: medicine, pharmacy, nursing and health policy, to improve the performance of the health system without adding much resources but improving the efficiency of the system. We also run research and implementation project that use the concepts we have delivered in the class room to improve performance.

■ MC37

Level 2 - Room 213A

Supply Chain Scheduling in Industry and Terminal Operations

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Lixin Tang, Professor, Northeastern University, The Logistics Institute, Shenyang, 110819, China, lixintang@mail.neu.edu.cn

1 - Flexible Yard Storage for Transshipment Hub Port

Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, 119260, Singapore, iseleelh@nus.edu.sg

Consignment strategy is one of the common yard strategies use to address how to assign container types to yard locations. This strategy facilitates fast vessel turnaround, but it is not efficient in space utilization. We will present a flexible container storage that increases space utilization and retains the consignment concept.

2 - Proactive and Efficient Spare Parts Inventory Management Policies

Jingyao Gu, University of Windsor, 401 Sunset Avenue, Windsor, ON, N9B 3P4, Canada, gujingyao2013@gmail.com, Guoqing Zhang, Kevin Li

We study multiple spare parts inventory problems with a budget constraint. The non-linear programming models are developed to obtain optimal spare parts replenishment policies for failure-based maintenance in a single period. We explore a Lagrangian relaxation heuristic method by relaxing the budget constraint and decomposing the large size problem into multiple single PN sub-problems.

3 - Coordinated Scheduling of Production and Storage/Retrieval in the Steel Industry

Feng Li, PhD, The Logistics Institute, Northeastern University, Shenyang, 110819, China, fengli055@gmail.com, Lixin Tang

This talk discusses a coordinated scheduling of production and storage/retrieval that commonly occurs in the production and warehousing operations in the steel industry. The problem can be classified as follows: 1) Coordinated scheduling of steelmaking-continuous casting production and slab storage; 2) Coordinated batching scheduling of hot rolling production and slab retrieval; 3) Coordinated batching scheduling of cold rolling production and coil storage/retrieval.

4 - Exact Algorithms for Stack Slab Shuffling Problem in Steel Industry

Xu Cheng, PhD, Northeastern University, The Logistics Institute, Shenyang, 110819, China, chengxv@gmail.com, Lixin Tang

Steel slabs are stored vertically in slab yard, as a result,shuffle operation is needed when retrieving interlayer slab. Given a sequence of slab requirement, deciding which slabs should be chosen as the target slabs, aiming at minimum shuffle number is Slab Stack Shuffling problem. This paper formulate this problem as an ILP model. Column generation and DP algorithms are developed to solve it. Computation results show that exact algorithms can get optimal solutions in a shorter time than CPLEX.

5 - SDP and SOCP based Method for the Robust Material Allocation Planning Problem

Yuan Yuan, Phd, The Logistics Institute,Northeastern University, Shenyang, LN, 110819, China, yyuan.tli@gmail.com, Lixin Tang

We investigate a new type of material allocation problem, in which there is some uncertainty or variation in the parameters. We formulate the problem as a 0-1 integer linear programming model and transform it to a 0-1 second-order cone program. A semidefinite relaxation is proposed, from which we get a lower bound. We also develop a heuristic approach to gain near optimal solutions for the problem. Some valid inequalities are added to reduce the gap between lower bound and objective value.

■ MC38

Level 2 - Room 213B

Multi-objective Optimization and Applications

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Ralph E. Steuer, Professor, University of Georgia, Department of Finance, Brooks Hall, Athens, GA, 30602, United States of America, rsteuer@uga.edu

1 - Multi-objective Optimization g for a Novel Batch Scheduling Problem

Jun Pei, Ph.D, University of Florida, 401 Weil Hall PO Box 116595, Gainesville, FL, 32611-6595, United States of America, peijun@ufl.edu, Xinbao Liu, Wenjuan Fan

This paper investigates a novel multi-objective model for a batch scheduling problem with mould capability constraint that minimizes both the total completion time of the jobs and the total cost of the moulds. We develops a new multi-objective algorithm based on the features of gravitational search algorithm. The computational results demonstrate that our proposed MOGSA algorithm outperforms NSGA-II and SPEA-II in terms of the convergence and diversity level of solutions.

2 - Optimizing the Dose and Delivery of Influenza Vaccine using a Multi-Objective Simulation Approach

Wei Bao, Graduate Assistant, University of Arkansas, 4207 Bell Engineering, Fayetteville, Ar, 72701, United States of America, weibao@email.uark.edu, Shengfan Zhang

We present a multi-objective simulation optimization model to determine the number of doses and delivery of influenza vaccine before seasonal influenza outbreaks. The demand and timing for flu shots is uncertain, especially for areas with high risk of infection. We develop a simulation model for an optimal vaccine production and delivery policy considering three different perspectives: individual, society and vaccine manufacture.

3 - Extracting from the Conventional for the Semi-continuous Variable Efficient Frontier

Ralph E. Steuer, Professor, University of Georgia, Department of Finance, Brooks Hall, Athens, GA, 30602, United States of America, rsteuer@uga.edu

Given the (a) speed at which the efficient frontier of a conventional portfolio selection problem can now be computed and (b) likelihood that a conventional efficient frontier will have overlaps with the efficient frontier of the same problem but with semi-continuous variables, this paper investigates the time savings that can be achieved when constructing semi-continuous variable efficient frontiers when exploiting these observations.

■ MC39

Auditorium 3

Daniel H. Wagner Prize III

Cluster: Daniel H. Wagner Prize

Invited Session

Chair: Allen Butler, President, Daniel H Wagner Associates, Inc., 2 Eaton Street Suite 500, Hampton, VA, 23669, United States of America, Allen.Butler@va.wagner.com

1 - Wagner Prize

Allen Butler, President, Daniel H Wagner Associates, Inc., 2 Eaton Street Suite 500, Hampton, VA, 23669, United States of America, Allen.Butler@va.wagner.com

The competition for the 2013 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in sux finalists, who submitted papers to the judging committee and who will present their results in three sessions . The winner will be announced and give a reprise in a Tuesday afternoon Keynote session.

2 - Matching Supply and Demand via Delayed 2-Phase Distribution at Yedioth Group – Models, Algorithms and IT

Y.T. Herer, Associate Professor, Technion - Israel Institute of Technology, Industrial Engineering and Mangement, Haifa, Israel, yale@technion.ac.il, Retsef Levi, A. Avrahami

Using in-cycle sales information, we develop an innovative pooling model of Delayed Distribution, and practical optimization algorithms. Enabled by EDI/RFID systems, the models and algorithms were implemented in Yedioth, the largest media group in Israel, to support distribution decisions of its print magazines. Dramatic reduction in production and return levels with same levels of sales were documented. The new distribution model is piloted in other industries, and opens new research questions.

3 - Modeling and Optimizing Emergency Department Workflow

Eva Lee, Professor and Director, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, evakylee@isye.gatech.edu

Emergency department operations present numerous challenges for systems optimization. The human-centered service environment is complex and volatile, both for patients and care providers. In this paper, a system is described that couples machine learning, simulation and optimization decision support to improve the efficiency and timeliness of care in the emergency department, while reducing avoidable re-admissions. The model allows one to optimize the ED workflow globally, taking into account the uncertainty of human disease characteristics and care patterns, so as to drive the length of stay and wait-time for patients to a minimum.

■ MC41

Level 1 -101A

Customer Oriented Operations Models

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Fuqiang Zhang, Associate Professor, Washington University, Simon Hall 236, St. Louis, United States of America, FZhang22@WUSTL.EDU

1 - Bounded Rationality and Forecast Information Sharing

Fei Gao, University of Pennsylvania, University of Pennsylvania, Philadelphia, United States of America, feigao@wharton.upenn.edu, Xuanming Su

We develop a model of bounded rationality based on iterative thinking. We apply the model to study forecast information sharing in supply chains. Our results shed light on how trust between supply chain partners forms and evolves over time.

2 - Dynamic Pricing of Experience Goods: The Impact of Consumer Reviews

Laurens Debo, Associate Professor, University of Chicago, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu, Man Yu, Roman Kapuscinski

In this talk, we focus on dynamic pricing of experience goods whose quality is initially unknown both to consumers and to the firm, but the early buyers can communicate their experiences after consumption via e.g. word-of-mouth, websites, smartphones applications or other media.

3 - Price Commitments with Strategic Consumers

Pnina Feldman, University of California-Berkeley, 545 Student Services Bldg, #1900, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu, Gerard Cachon

Firms may benefit from making price commitment when consumers are strategic. But which price commitment strategy should firms implement? We examine commonly used pricing strategies and propose a new pricing strategy in which the firm commits to discount more frequently than optimal. In a setting where consumers are strategic and incur a cost to search the firm, we show that discount frequently performs the best and in many cases it is optimal (equivalent to maximum social welfare).

4 - Revenue Management with Upgrading and Opportunistic Behavior

Fuqiang Zhang, Associate Professor, Washington University, Simon Hall 236, St. Louis, United States of America, FZhang22@WUSTL.EDU, Yueshan Yu, Guang Xiao

In this paper we study the impact of opportunistic behavior on a firm's selling strategy. The firm sells two products and uses the high-quality product to upgrade the demand for low-quality product if needed. Customers can be opportunistic in the sense that they purposely choose to buy the low-quality product in anticipation of upgrading. We find that such opportunistic behavior may either hurt or benefit the firm depending on different conditions.

■ MC42

Level 1 -101B

Sustainable Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Vishal Agrawal, Assistant Professor, Georgetown University, 37th & O Streets, 200 Hariri Building, Washington, DC, 20057, United States of America, va64@georgetown.edu

1 - Time to Come Clean? Disclosure and Inspection Policies for Green Production

Sang Kim, Associate Professor, Yale University, New Haven, CT, 06520, United States of America, sang.kim@yale.edu

We examine the interplay between two important policies that impact the environmental performance in a production setting: inspections performed by a regulator and noncompliance disclosure by a manufacturing firm. We study this problem by developing a novel analytical framework that combines the features from reliability theory and law enforcement economics. The analysis reveals new insights that counters the established notions.

2 - Mechanisms for Increasing Locally Sourced Fresh Produce

Deishin Lee, Boston College, Boston, MA, United States of America, deishin.lee@bc.edu, Baris Ata, Mustafa Tongarlak

We study two mechanisms for incorporating more locally sourced fresh produce into the food supply chain: backhauling (used by Walmart) and differentiation (used by Red Tomato). We show that there can be a tradeoff between leveraging operational efficiency and capturing demand-side value. Moreover, the two mechanisms can be substitutes.

3 - Competitive Supplier Responsibility and Sourcing Decisions in Decentralized Supply Chains

Ruixue Guo, Doctoral Student, Stanford University, Stanford, CA, 94305, United States of America, rguo@stanford.edu, Hau L. Lee, Robert Swinney

We analyze the responsibility decisions of two suppliers who compete for the business of a single buyer. The suppliers may invest to adhere to social and environmental responsibility standards, reducing the probability of a violation that might negatively impact the buying firm. We examine the equilibrium outcome of this competition and consider its sensitivity to market and supply chain conditions.

4 - The Potential of Servicing as a Green Business Model

Vishal Agrawal, Assistant Professor, Georgetown University, 37th & O Streets, 200 Hariri Building, Washington, DC, 20057, United States of America, va64@georgetown.edu, Ioannis Bellos

In recent years, manufacturers in various industries have begun to orient their practices towards selling the use of the product as opposed to selling the product itself. We investigate the economic and environmental implications of the manufacturer's design and pricing decisions under different forms of servicizing business models.

■ MC43

Level 1 -101C

Capacity Management and Information

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Noam Shamir, Assistant Professor, Tel-Aviv University, Tel-Aviv, Israel, nshamir@post.tau.ac.il

1 - Effect of Upstream Competition in Spot Market on Short Life Product Supply Chain

Oleksii Nikulkov, PhD Student, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, nikulkov@stanford.edu, Hau L. Lee

We allow wholesale price in supply chain with competing suppliers to be determined based on spot market quantity competition. Such pricing mechanism has potential to align supply chain by internalizing externalities of retailer's order. We compare our results to the model with monopolistic supplier and find that strong competition in spot market always benefits the supply chain, but moderate competition in multi-period setting could degrade supply chain performance.

2 - Optimal Surge Capacity Management and Information Sharing for Emergency Departments

Maria Shunko, Purdue University, West Lafayette, IN, United States of America, mshunko@purdue.edu, Varun Gupta, Alan Scheller-Wolf

While many emergency departments (ED) in the US experience crowding, ambulances make decisions for patients' routing without information from the EDs, which worsens crowding. EDs try to overcome crowding using surge capacity. We find the optimal surge capacity policy and compare ED profit and patient wait time in two cases: 1) EDs share information, the central controller makes routing decision, and 2) ambulances make decision independently.

3 - Supply Diagnostic Incentives in New Product Development

Mehmet Gumus, McGill University, Montreal, QC, Canada, mehmet.gumus@mcgill.ca, Mohammad Nikoofal

In launching new products, the newness of the production leads to unexpected reliability issues on supply side. The adverse effect of supply risk can be mitigated via test production. We explore how such a diagnostic technology investment may affect both incentive and information asymmetries across channel partners.

4 - Who Benefits from Joint Forecast? The Case of a Trade Association and a Strategic Manufacturer

Noam Shamir, Assistant Professor, Tel-Aviv University, Tel-Aviv, Israel, nshamir@post.tau.ac.il, Hyoduk Shin

We study the incentives of a group of retailers, organized as a trade-association, to share their forecast, when they source the product from a mutual manufacturer. We demonstrate that having better-forecast can make the retailers worse-off. We offer a few ways that can increase the efficiency of this supply-chain.

■ MC44

Level 1 -101D

Industry Job Search Panel

Cluster: INFORMS Career Center (formally JPS)

Invited Session

Chair: Neil Geismar, Texas A&M University, College Station, TX, United States of America, ngeismar@mays.tamu.edu

1 - Panel Discussion: Industry Job Search

Moderator: Jack Kloeber, Principal, Kromite, Chruchville, PA, United States of America, jkloeber@kromite.com, Panelists: Dan Nottestad, Warren Hearnes

The panel will discuss the industry interview process and do's and don'ts associated with the job search. In addition to comments from current and former recruiters, time will be provided for questions and answers.

■ MC45

Level 1 -101E

Topics in Aviation Contracts

Sponsor: Aviation Applications

Sponsored Session

Chair: Nishant Mishra, Rotterdam School of Management, Erasmus University, Rotterdam, Netherlands, nmishra@rsm.nl

1 - Airline Contracts, Government Regulation and the International Airline Market

Benny Mantin, University of Waterloo, 200 University Avenue W, Waterloo, ON, N2L3G1, Canada, bmantin@uwaterloo.ca, Nicole Adler

Governments sign liberalization agreements to regulate the airborne traffic between the two countries, whereas airlines engage in code share contracts to set the level of coordination and pooling of resources. Empirically studying the effects of code share and liberalization agreements on international non-stop routes, we find that the level of the liberalization agreement has a significant impact on frequency, and that the types of code share agreements have different effects on airfares.

2 - Multi-sided Analysis of Airport - Airline Risk Sharing Contract

Katsuya Hihara, U-Tokyo, 2nd Admin Bureau BLGD 7-3-1 Hongo Bunkyo, Tokyo, To, 113-0033, Japan, hihara@pp.u-tokyo.ac.jp

We analyze linear risk sharing contract between airport and airline with multi-sided aspects. With modeling their contract including demand uncertainties, we show how such contracts are formed and illustrate the impacts of changes of, for example, risk aversions, land-side productivities of airports, on prices and welfares.

3 - Development of AHP Methodology to Improve the Resilience of Barranquilla International Airport

Luis Ramirez, Docente, Universidad Autonoma del Caribe, Cra 46 No 88-15, Barranquilla, Colombia, luis.ramirez@uac.edu.co, Fabian Sanchez, Andrea Roa, Daniel Romero, Daniela Esmeral

This paper shows the implementation of the methodology AHP (Analytic hierarchy process) to improve resilience to factors that alter the normal operations of the International airport of the city of Barranquilla Colombia. The paper specifies the internal and external factors, social environmental or mechanical that influence operations, and how to evaluate the proposed strategies to build resilience to these.

■ MC46

Level 1 -101F

Operations and Finance Interface

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Wei Luo, IESE Business School, Avenida Pearson, 21, Barcelona, Spain, wluo@iese.edu

Co-Chair: Kevin Shang, Duke University, United States of America, kevin.shang@duke.edu

1 - Integrating Inventory Replenishment and Trade Credit in One-Warehouse-Multi-Retailers System

Chung Piaw Teo, Professor, National University of Singapore, Mochtar Riady Building, BIZ1-7-71, 15 Kent Ridge Drive, Singapore, 119245, Singapore, bizteocp@nus.edu.sg, Mabel Chou, Yuanguang Zhong

We use the classical echelon inventory approach to synthesize the effects of trade credits in a one-warehouse-multi-retailer system. We obtain a closed form (but non convex) expression for the total supply chain cost. Interestingly, we show that longer credit terms from the external supplier may not necessarily translates into longer credit terms for the retailers in some supply chain environments.

2 - When Distressed Retailers Met Smart Customers: The Implication of Liquidation Sales

Xiao Wu, Student, University of Chicago, Booth School of Business, 5807 South Woodlawn Ave., Chicago, IL, 60637, United States of America, xwu6@chicagobooth.edu, S. Alex Yang, Rodney Parker, John Birge

In this paper, we investigate a financially distressed retailer's inventory and pricing decisions in the presence of strategic consumers. The retailer has to make three decisions: initial price, initial stocking quantity, and liquidation price. Our results show that understanding the interaction between a firm's financial condition and the consumers it faces is very important. Ignoring this linkage could lead to substantial losses.

3 - Pre-shipment Financing: Credit Capacities and Supply Chain Consequences

Matthew Reindorp, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, m.j.reindorp@tue.nl, Anna Lange, Fehmi Tanrisever

We study a supply chain where a retailer buys from a debt-constrained supplier. The retailer commits to a minimum purchase quantity to facilitate pre-shipment financing, which enables the supplier to extend his debt capacity and indirectly also his production level. Key parameters are the creditworthiness of the retailer and the supplier, and the characteristics of the product market. Using a newsvendor model, we analyze the strategic interaction of the two players as a Stackelberg game.

4 - Joint Inventory and Cash Management for Multi-Divisional Supply Chains

Wei Luo, IESE Business School, Avenida Pearson, 21, Barcelona, Spain, wluo@iese.edu, Kevin Shang

This paper studies a centralized supply chain with different levels of cash concentration. For cash pooling, we develop the optimal joint inventory replenishment and cash retention policy; for transfer pricing, we derive a cost lower bound. The comparison between these two systems shows the conditions under which the value of cash pooling is most significant.

■ MC47

Level 1 -101G

Empirical Research in Service Operations

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Jose Guajardo, Assistant Professor, Haas School of Business, University of California Berkeley, Berkeley, United States of America, jguajardo@haas.berkeley.edu

1 - e-Visits in Primary Care

Hessam Bavafa, Ph.D. Candidate, The Wharton School, University of Pennsylvania, Philadelphia, PA, United States of America, bavafa@wharton.upenn.edu, Christian Terwiesch

The technology for secure messaging between provider and patients, e-visits, has been utilized for several years and many view it as a potential solution for improving quality of health services while reducing costs. This project will be the first to disentangle the impact of e-visits on patient health outcomes and physician workload by using a credible empirical strategy.

2 - How Delay Announcements Shape Customer Behavior: An Empirical Study

Qiuping Yu, Northwestern University, Evanston, IL, United States of America, QiupingYu2009@u.northwestern.edu, Gad Allon, Achal Bassamboo

We explore the impact of delay announcements by studying the data from a medium sized call center, where customers are provided with anticipated delay. Our key insights show that delay announcements not only impact customers' beliefs about the system, but also directly impact customers' per unit waiting cost. Specifically, customers' per unit waiting cost decreases with the offered waiting times associated with the announcements.

3 - The Customer May Not Always Be Right: Customer Compatibility and Service Performance

Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu, Dennis Campbell, Frances Frei

We decompose the variance of 58,294 face-to-face retail banking transactions, quantifying the relative importance of customer, employee, process, location, and market-level effects on transaction satisfaction. In our models, customer-level differences account for a vast majority of the explainable variance. Subsequent customer, branch, and firm-level analyses suggest that these differences are explained in part by the degree of compatibility between each customer and the firm's operating system.

4 - Third Party Ownership in the Solar Energy Market

Jose Guajardo, Assistant Professor, Haas School of Business, University of California Berkeley, Berkeley, United States of America, jguajardo@haas.berkeley.edu

Third party ownership has become a prevalent business model in the solar energy market. I analyze the drivers and effects of this business model in the context of industry incentives, supply chain structure and market outcomes.

■ MC48

Level 1 -101H

INFORMS Connect: Networking, Online Collaboration, & Communities

Cluster: INFORMS Communities

Invited Session

Chair: Mary Leszczynski, Design & Brand Manager, INFORMS, 5521 Research Park Drive, Catonsville, MD, United States of America, mary.leszczynski@informs.org

1 - INFORMS Connect: Networking, Online Collaboration, & Communities

Mary Leszczynski, Design & Brand Manager, INFORMS, 5521 Research Park Drive, Catonsville, MD, United States of America, mary.leszczynski@informs.org

INFORMS newest member benefit, INFORMS Connect, is a members-only online network to connect with fellow INFORMS members, collaborate on projects, and manage your community activity. You will be able to search for other members based on keywords, contribute to OR/MS and analytics knowledgebase, view your INFORMS Community content, and set your preferences for Community list-serve deliveries. See a demonstration of how INFORMS Connect works, have your questions answered, and do some IRL (in real life) networking with colleagues.

■ MC49

Level 1 -101I

Optimal Placement in a Limit Order Book

Cluster: Tutorials

Invited Session

Chair: Xin Guo, University of California-Berkeley, Berkeley, CA, 94708, United States of America, xinguo@berkeley.edu

1 - Optimal Placement in a Limit Order Book

Xin Guo, University of California-Berkeley, Berkeley, CA, 94708, United States of America, xinguo@berkeley.edu

Algorithmic trading refers to the automatic and rapid trading of large quantities with orders specified and implemented by an algorithm. It essentially involves two steps by which the traders slice and place orders. The first step is known as the optimal execution problem and the second step is the much less-studied optimal placement problem. This tutorial reviews several simple models and approaches for the optimal placement problem, together with some relevant statistical issues.

■ MC50

Level 1 -101J

Energy I: Nonrenewable Resources and Power Generation

Contributed Session

Chair: Ali Nouri Dariani, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, nouri@stanford.edu

1 - Natural Gas Storage Decision Making Strategies

Ebisa Wollega, PhD Candidate, University of Oklahoma, 202 W. Boyd St., Norman, OK, 73019, United States of America, ebisa@ou.edu

In this presentation, we compare three natural gas storage optimization operations. The operations are used by natural gas storage facility contractors to make injection and withdrawal decisions over a specific storage facility lease period.

2 - Integrated Natural Gas Pipeline and Electricity Generation and Transmission Expansion Planning

Ahmet Akgun, Wichita State University, 3540 N. Inwood #11305, Wichita, KS, 67226, United States of America, akgun1054@hotmail.com

A mathematical programming model for integration of electricity generation and transmission expansion planning and natural gas pipeline network problem is proposed to analyze the impact of the natural gas cost on the new investment decisions. The proposed model optimizes the operation, transmission and investment costs for both systems at the same time. This paper aims to determine what kind of generation units to be built, where to build those generation units, and when to build.

3 - Modeling and Global Optimization of Multi-operations Sequence Models for Crude Oil Operations

Xuan Chen, Dr., IBM, Building 19 Zhongguancun Software Park, Beijing, 100094, China, chenxuan@cn.ibm.com

This paper extends the multi-operations sequence (MOS) models for crude oil operations proposed by Mouret et al. (2010). A procedure is presented to automatically generate the set of operations and non-overlapping cliques sets for the MOS model from the resource-based input of the refinery. The model is enhanced to incorporate many practical features. We also apply modified multi-parametric disaggregation, a recent global optimization technique to the resulting mixed integer bilinear model.

4 - Equilibrium Convenience Yield and Price Dynamics of Depletable Natural Resources

Ali Nouri Dariani, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, nouri@stanford.edu

Inventory dynamics, supply scarcity, demand stochastic growth and financial markets are considered to be four main drives of commodity prices in short term. This paper presents an equilibrium convenience yield model in which inventories, resource owners, and speculators optimize simultaneously. The model brings new insights on the constraints that market structure imposes on price dynamics. Numerical results are presented for crude oil market.

■ MC51

Level 1 -102D

Network Design and Routing with Robust Concerns and Operational Choice

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu

Co-Chair: Mark Daskin, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, United States of America, msdaskin@umich.edu

1 - The Periodic Location Routing Problem with Operational Choice

Luis de la Torre, PhD Candidate, Northwestern University, 2145 Sheridan Road, C210, Evanston, IL, 60208, United States of America, ledelatorre@u.northwestern.edu, Karen Smilowitz, Vera Hemmelmayr

We introduce variants of periodic location routing with several dimensions of operational choice: eligible depots are selected from the customer set; the capacity of the depots is a variable independent of depot location; and the frequency of node visits is a decision variable. We present a mathematical formulation and analyze the challenges introduced by operational choice. We use this analysis to develop solution methods, and present a case study on recycling for food pantries in Chicago.

2 - Robust Facility Location under Demand Location Uncertainty

Auyon Siddiq, University of Toronto, 5 King's College Road, Toronto, Canada, asiddiq@mie.utoronto.ca, Timothy Chan

We generalize classical facility location problems within a two-stage robust optimization framework by assuming each demand point is only known to lie within a continuous and bounded uncertainty region. We discuss an efficient row-and-column generation algorithm and present bounds on the error introduced by the discretization of the continuous uncertainty regions. We conclude with a computational study using cardiac arrest data from the City of Toronto.

3 - A Robust Optimization Approach for Adaptive Traffic Signal Control with Emission Constraints

Hongcheng Liu, PhD Candidate, Pennsylvania State University, 240 Leonhard, University Park, PA, United States of America, hql5143@psu.edu, Tao Yao, Ke Han, Terry Friesz

We consider an adaptive signal control problem using the LWR model, with vehicle emission side constraints. We uncover, through numerical simulation, certain relationship between macroscopic traffic and emission quantities. Such relationship is combined with robust optimization techniques to reduce the problem to a mixed integer linear program, efficiently solvable with standard software.

4 - Robust and Semi-robust Network Design under Demand and Topological Uncertainty

Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu, Mingdi You

We design robust/semi-robust networks for stochastic demand and topological parameters subject to independent uncertainty sets. Depending on how much data available, we minimize the maximum/expected losses by using robust/stochastic optimization models. The semi-robust approach employs SAA while bounding the maximum loss. Different cutting planes are developed to improve the computational efficacy.

■ MC52

Level 1 -102E

Logistics & Supply Chain Management: Industry Applications

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Gopalakrishnan Easwaran, Associate Professor, St. Mary's University, One Camino Santa Maria, MS 34, Engineering Dept, St. Mary's Univ, San Antonio, TX, 78228-8534, United States of America, geaswaran@stmarytx.edu

1 - An International Supply Chain Network Design Model for Rafael-de-Mexico

Gopalakrishnan Easwaran, Associate Professor, St. Mary's University, One Camino Santa Maria, MS 34, Engineering Dept, St. Mary's Univ, San Antonio, TX, 78228-8534, United States of America, geaswaran@stmarytx.edu, Archana Shankarnarayanan, Nestor Moreno, Alejandra Mireles

Considering an international business expansion problem for a small scale, home dÉcor products fabrication firm located in Mexico, namely, Rafael-de-Mexico, we develop and solve a comprehensive supply chain network design model for maximizing the company's return on investment. The model includes explicit consideration of constraints pertaining to procurement, aggregate planning, international shipments, warehousing, resource planning, accounting regulations, sales, and corporate finance.

2 - Retail Pricing Strategy in Competitive Market

Xingchu Liu, VP, Data Analytics and Research, Blacklocus, Home Depot Innovation Lab, 804 Congress Ave., Austin, TX, 78701, United States of America, xingchu@blacklocus.com

Retail pricing becomes more competitive as online services bring more transparency to prices and product availability. In this paper, we investigate retailer's pricing strategies and their impact.

3 - Network Modeling and Planning Implementations in Starbucks Supply Chain

Stephen Stoyan, Analytics Manager, Starbucks Coffee Company, 2401 Utah Ave. S., Seattle, WA, 98134, United States of America, sstoyan@starbucks.com

The supply chain network at Starbucks Coffee Company is facing new complexities on how products are shipped, stored, and distributed in the network. The advanced analytics team at Starbucks has developed an approach that tackles new challenges faced in the network as well as a tool that integrates with current systems to interact with business partners and aid with complexities. We present Phase I of the system that computes a production distribution hierarchy and inventory hedging strategy.

■ MC53

Level 1 -102F

Facility Logistics -IV

Sponsor: Transportation Science & Logistics/Facility Logistics

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, Madison, WI, United States of America, ananth@engr.wisc.edu

1 - Designing Public Storage Warehouses with Customer Choice

Yeming Gong, Associate Professor, EM Lyon Business School, 23 Avenue Guy de Collongue, Ecully, 69134, France, Gong@em-lyon.com

Customer choice behavior is an important element in revenue management of public storage warehouses. To consider this behavior, the customer choice model is used to specify the probability of purchase for each fare product as a function of the set of fare products offered. This paper proposes models and solving algorithms to design public storage warehouses with considering the choice behavior of customers.

2 - An Analytical 3-Dimensional Bin-Packing Model

Yupo Chan, University of Arkansas at Little Rock, 2801 S University, Little Rock, AR, 72204, United States of America, yxchan@ualr.edu, Ghulam Rasool, James Moore, Gregory Taylor, Richard Cronk

An analytical model is offered to the 3-dimensional bin-packing problem. The model yields Pareto optima, rather than a single optimum. To speed up the solution algorithm, all available boxes to be packed were first sorted in a non-decreasing fashion according to their height and later packed layer-by-layer. Relaxation of the model is shown to be the linear-programming bound advanced by Federgruen and Van Ryzin for heuristic solution.

3 - Competitive Analysis of Port Production and Trucking Emissions

Bruce Hartman, Professor, University of St., Francis, 500 Wilcox St., Joliet, IL, 60435, United States of America, bhartman@stfrancis.edu, Christopher Clott

Controlling harbor truck emissions is an important requirement for sustainable port operations. The burden imposed may well drive business to other ports. We use a nonlinear optimization model with Cournot competition between ports for throughput at a given emissions level; a port chooses the percentage of trucks to upgrade. We identify shadow prices for emission levels and output, and determine whether side payment subsidies to insure cooperation are necessary.

4 - An Exact Algorithm for the Vehicle Routing Problem with Time Windows and Multiple Shifts

Said Dabia, TU/e, Pav F 19, Eindhoven, 5600MB, Netherlands, S.Dabia@tue.nl, Tom van Woensel, Stefan Ropke

We solve he Vehicle Routing Problem with Time Windows and Multiple Shifts by a branch-and-cut-and-price algorithm. The master problem is a set partitioning with an additional constraint for every shift. Each constraint requires the total quantity loaded to be less than the shift's loading capacity. For every shift, a pricing problem is solved by a labeling algorithm. Shift capacity constraints define knapsack structures. Hence, we use knapsack valid inequalities to get stronger lower bounds.

■ MC54

Level 1 -103A

Dynamic Traffic Assignment II - Applications

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Rui Ma, Research Assistant, Rensselaer Polytechnic Institute, 110 8th Street, JEC 5107, Troy, NY, 12180, United States of America, mar2@rpi.edu

1 - Towards More Realistic Mobile-Source Emissions Analysis via Dynamic Traffic Assignment

Rohan Shah, Grad. Research Asst., The University of Texas at Austin, 301 E Dean Keeton Stop C1761, Austin, TX, 78712, United States of America, rohanshah@utexas.edu, Nezamuddin N., Stephen Boyles

Vehicular emissions models generally use time-aggregated or averaged traffic conditions in estimations. But in reality, traffic flows are essentially 'dynamic', with network congestion locations, drivers' route choices and flow characteristics in general varying temporally, which can have significant implications on emissions. The study employs dynamic traffic assignment to account for them and implement more realistic emissions modeling in practice.

2 - Emission Modeling and Control in Dynamic Traffic Networks

Rui Ma, Research Assistant, Rensselaer Polytechnic Institute, 110 8th Street, JEC 5107, Troy, NY, 12180, United States of America, mar2@rpi.edu, Xuegang Ban

We study the network-wide emission control problem by modeling the dynamic evolution of network traffic states. Numerical results are shown to illustrate the proposed modeling approach.

3 - Using Large-scale Traffic Simulation Models to Inform the Design of Vehicle Sharing Networks

Carolina Osorio, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 1-232, Cambridge, MA, 02139, United States of America, osorioc@mit.edu, Krishna Selvam, Cynthia Barnhart, Virot Chiraphadhanakul, Erica Klampfl, Yimin Liu

We develop an optimization framework to inform the design of vehicle sharing networks. The framework embeds an urban traffic simulation model, which provides a detailed description of how modal shifts impact both link and network-wide traffic metrics. We use the framework to identify locations for vehicle sharing stations that lead to maximal improvements in network-wide metrics.

4 - Quantifying the Impact of Time Aggregation in the Computation of Time-dependent Shortest Path in DTA

Natalia Ruiz Juri, Universitiy of Texas at Austin, 1616 Guadalupe St. Suit 4.202, Austin, Tx, 78701, United States of America, natiruizjuri@gmail.com, S.Travis Waller, Jennifer C. Duthie, Michael Levin

Typical DTA model runs involve a very large number of time-dependent shortest path computations. The link travel time aggregation used in these calculations is usually chosen based on computational performance considerations. This work explores the impacts of such discretization on DTA model convergence and results. Our conclusions may be used to assess the importance of adopting more efficient TDSP algorithms in large-scale DTA implementations.

■ MC55

Level 1 -103B

Disaster Preparedness and Emergency Planning

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Elise Miller-Hooks, University of Maryland, 1173 Glenn Martin Hall, Dept. of Civil & Env. Eng., College Park MD 20742, United States of America, elisemh@umd.edu

1 - Optimization Model and Solution Approach for an Integrated Relief Network Design

Jyotirmoy Dalal, Ph D candidate, Texas A&M University, Industrial and Systems Eng. Dept., 3131 TAMU, College Station, TX, 77840, United States of America, jyotirmoy.dalal@gmail.com, Halit Uster

We consider an integrated strategic relief network design problem focusing on both fast evacuation and cost-effective distribution. We present a new solution approach combining exact optimization and heuristic techniques to solve our deterministic, multi-objective, mixed integer linear model. We present computational results and analysis providing managerial insights.

2 - Stochastic and Robust Optimization Approaches to the Design of Evacuation Systems in Buildings

Reza Faturechi, University of Maryland, 1173 Glenn L. Martin Hall, University of Maryland, College Park, MD, 20742, United States of America, reza@umd.edu, Elise Miller-Hooks, Shabtai Issac, Lei Feng

In this work, techniques of bilevel programming, stochastic programming and robust optimization are applied in the robust design of shelters and exits in building environments under multi-hazard disaster scenarios. Shelters and exits are designed with the aim of minimizing risk exposure during hazard events while adhering to budgetary and other constraints. User equilibrium and system optimum solutions from the lower level of a bilevel program formulation are explored and interpreted.

3 - Planning for Disruptions in Facility Location Models

Kaiyue Zheng, University of Wisconsin-Madison, Industrial & Systems Engineering, Madison, WI, 53706, United States of America, kzheng23@wisc.edu, Laura McLay

To hedge against the risk of interdictions to facility systems, planners may fortify the existing network to make it more reliable, or design a network that is resilient to disruptions. We present models addressing both topics, including a defender-interdictor location model with uncertain futures, and a location design model with heuristic and optimal interdictions. Algorithms are discussed for both models.

4 - Debris Removal During Disaster Response Phase: A Case For Turkey

Bahar Kara,Assoc. Prof., Bilkent University, Bilkent Universitesi, Endustri Muh., Ankara 06800, Turkey, bkara@bilkent.edu.tr, Oya Karasan, Halenur Sahin

Proper removal of debris has significant importance since it blocks the roads and prohibits emergency aid teams to access the disaster affected regions. The focus of this study is to develop mathematical models that select the paths in order to transport emergency aid materials in the presence of debris to the pre-determined disaster affected regions. The performances of the models are tested on two distinct data sets from Istanbul. Since it is crucial to act quickly in an emergency case, a constructive and an improvement heuristic are also proposed.

■ MC56

Level 1 -103C

Applications of Parallel Computing in Energy Systems Planning and Operations (Part II)

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Anthony Papavasiliou, Assistant Professor, Catholic University of Louvain, Voie du Roman Pays 34, Office b.114, Louvain la Neuve, 1348, Belgium, anthony.papavasiliou@gmail.com

1 - A Practical Approach to Force Progressive Hedging Convergence for Stochastic Unit Commitment

Garret LaBove, Research Assistant, Arizona State University, PO Box 875706, GWC 206 School of ECEE ASU, Tempe, AZ, 85287-5706, United States of America, garret@asu.edu, Kory Hedman

Computationally efficient methods to solve stochastic unit commitment will be required in order to ensure system reliability at least cost for systems with high levels of intermittent, non-dispatchable renewable resources. This talk will present a parallelized progressive hedging framework for unit commitment while considering N-1 reliability and renewable uncertainty combined with out-of-market correction procedures to improve convergence.

2 - Parallel Branch and Fix Coordination with Decomposition Schemes

Gerardo Alfredo Perez Valdez, Postdoc, NTNU, Alfred Getz vei 3, Trondheim, Norway, gerardo.valdes@iot.ntnu.no, Adela Pages-Bernaus, Asgeir Tomasgard

We apply a Branch and Fix Coordination algorithm in a parallel setting to solve large Stochastic Mixed-Integer Programs in the context of energy investment/operation. To handle large instances, we use the decomposition already required by the BFC in an L-shaped method, and Lagrangean decomposition, to solve LPs and improve the bounding throughout the process. Preliminary results show that a careful selection of the subproblems can perform better when compared to solving the original SMILPs.

3 - A Hybrid Parallel Decomposition Scheme for Nested Benders Decomposition

Andre Diniz, DSc, CEPEL, Rua Dois de Dezembro 123/601, Rio de Janeiro, RJ, 22220-040, Brazil, diniz@cepel.br, Tiago Santos

Parallel processing is usually applied to different scenario paths in stochastic programming. We propose a new hybrid parallel processing scheme to solve stochastic programs by nested Benders decomposition, where the parallelization is performed by subproblem in deterministic parts and near the beginning of the scenario tree (in order to avoid idle processors) and by scenario path further in the tree. Results are presented for the mid-term hydrothermal coordination problem.

4 - Flexiramp Market Design for Real-Time Operations: Can It Approach the Stochastic Optimization Ideal?

Ben Hobbs, Director, E2SHI, The Johns Hopkins University, Baltimore, MD, United States of America, bhobbs@jhu.edu, Beibei Wang

Power market operators are creating short-run "flexiramp" markets to manage increased volatility of net loads due to renewables. We evaluate flexiramp market designs by comparing solutions of (1) a deterministic unit commitment and dispatch model with a flexible ramping constraint with (2) a stochastic unit commitment model. We compare them in terms expected performance, in terms of costs, prices, and reliability.

■ MC57

Level 1 -103D

Energy Market Models II

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Steven Gabriel, University of Maryland, College Park, MD, United States of America, sgabriel@umd.edu

1 - A Stochastic MPEC with an Application to Wastewater-derived Energy

Chalida U-tapao, PhD Candidate, University of Maryland, College Park, MD, United States of America, cutapao@umd.edu, Steven Gabriel

We present a stochastic mathematical program with equilibrium constraints (MPEC). This two-level problem is a stochastic model for wastewater-derived energy with a strategic wastewater treatment plant as the upper-level player. The lower-level players make up the fertilizer, natural gas, CNG and electricity markets. All players are price-takers. The strategic player's decisions involve converting uncertain amounts of biosolids into biogas and/or electricity for internal or external purposes.

2 - Natural Gas Trade within the EU: A Competitive and Spatially Integrated Single Market?

Olivier Massol, Assistant Professor, IFPEN, 228-232 Avenue Napoléon Bonaparte, Rueil-Malmaison, 92852, France, olivier.massol@ifpen.fr, Albert BANAL-ESTANOL

Existing empirical analyses of spatial market relationships do not consider arbitrage behavior. We propose an alternative methodology incorporating price, transfer cost, and trade flow data. An application to the pipeline connecting Belgium and the UK demonstrates that: (i) both markets have achieved a high degree of spatial integration, and (ii) the assumption of perfectly competitive arbitrages is firmly rejected by the data, suggesting the presence of market power.

3 - The KAPSARC Energy Model (Saudi Arabia)

Frederic H. Murphy, Professor, Temple University and KAPSARC, Broad and Montgomery, Philadelphia, PA, 19122, United States of America, fmurphy@temple.edu, Bertrand Rioux, Axel Pierru, Walid Matar

This MCP model, built initially to analyze domestic Saudi Arabian energy policies including the management of subsidies, provides an integrated view demonstrating the benefits of coordinating investments among key players in the economy. We examine planning for electricity, water, refined products, and petrochemicals in a context of administered prices. The model is a template for capturing the consequences of policymakers determining prices and quantity allocations in commodity markets.

4 - Two-level Mixed Integer Programming for Energy Conservation Measure Selection

Bill Champion, Director/Ph.D. Candidate, EMG Corporation, University of Maryland, 222 Schilling Circle Suite 275, Hunt Valley, MD, 21031, United States of America, bchampion@emgcorp.com, Steven Gabriel

Many states, local governments and authorities have been issued directives and mandates that require a percentage reduction in energy consumption. Project selection is made difficult given real-world constraints, limited resources to implement savings retrofits, various suppliers in the market and other project financing alternatives. This paper will demonstrate how two-level mixed integer programming is used to optimize the selection of energy conservation measures.

■ MC58

Level 1 -103E

Real Options

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Stein-Erik Fleten, Norwegian University of Science & Technology, Dept of Ind Econ & Tech Mgmt, Trondheim, Norway, stein-erik.fleten@iot.ntnu.no

1 - A Real Options Model for Regulatory Risk

Matt Davison, Professor, University of Western Ontario, London, ON, Canada, mdavison@uwo.ca, Christian Maxwell

The economic viability of Green energy projects may depend on subsidies or feed in tariffs. Energy infrastructure is long lived and can allow its operator real options to store energy or to switch one form of energy into another. Green energy developers are long options but short exposed to future unpredictable changes in subsidy levels. We use a corn ethanol case study to draw some public policy conclusions on the impact of these factors on green energy real options.

2 - Project Financing for Investments in Energy Technologies

Ryuta Takashima, Tokyo University of Science, 2641 Yamazaki, Noda-shi, Chiba, 278-8510, Japan, takashima@rs.tus.ac.jp, Kyoko Yagi, Shohei Ohata

In this paper we examine how the scheme of project financing affects the decisions of the investment in energy technologies as power generations in real options framework. We analyze the interaction between the investment decisions of a special purpose company which has an investment project and the debt-paying ability. We also show the relation between public and private financial institutions with respect to the debt guarantee. Additionally, we consider a suspending risk of plants operations.

3 - Technological Change: A Burden or a Chance

Verena Hagspiel, Associate professor, NTNU Norway, Alfred Getz vei 3, Trondheim, NO-7491, Norway, v.hagspiel@uvt.nl, Peter Kort, Claudia Nunes Philippart

We study the problem of a firm that produces with a current technology for which it faces a declining sales volume. It has two options: it can either exit this industry or invest in a new technology with which it can produce an innovative product. The resulting new market can be booming or ends up to be smaller than the old market used to be. We derive the optimal strategy of a firm for each scenario and specify the probabilities with which a firm would decide to innovate or to exit.

4 - Real Options Use in Scandinavia

Peter Molnar, postdoc, Norwegian University of Science and Technology, Alfred Getz vei 3, Trondheim, 7491, Norway, peter.molnar@iot.ntnu.no, Beate Wollen Steen, Anders Horn, Frode Kjarrland

We survey the CFOs of the 1500 largest companies from Scandinavia to study use of real options. Only 23 of the 384 respondents use real options. Large companies with high capital expenditures and high R&D intensity are more likely to use the method. Lack of familiarity is the most important reason for non-use. 70% of respondents are not familiar with real options. For those familiar with the framework, the complexity of real options analysis is the main hinder for implementation.

■ MC59

Level 1 -103F

Biofuel Supply Chain Design and Environmental Analysis

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Guiping Hu, Iowa State University, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu

1 - Integrated Supply Chain Design for Commodity Chemicals Production via Woody Biomass Fast Pyrolysis

Yanan Zhang, Mechanical Engineering, Iowa State University, Ames, IA, 50011, United States of America, yananz@iastate.edu, Guiping Hu, Robert Brown

This study investigates the optimal production planning and facility locations for commodity chemicals production via woody biomass fast pyrolysis and hydroprocessing. The locations and capacities of distributed preprocessing hubs and centralized biorefinery facilities are optimized by a mixed integer linear programming (MILP) model. The objective is to maximize the net present value for a 20-years project based on this pathway. This approach is illustrated through a case study in Minnesota.

2 - An Optimization Model for the Switchgrass-Based Biomass Production

Halil Cobuloglu, PhD Student, Wichita State University, 1627 Fairmount St., Wichita, KS, 67208, United States of America, halil.cobuloglu@gmail.com, Esra Buyuktahtakin

In this study, we propose an optimization model, which defines the best decision strategies for biomass production regarding seeding time and methods, land allocation, harvesting amount and time under limited budget while considering the environmental impacts. Results will be presented for switchgrass cultivation as a source of biomass in the State of Kansas.

3 - Multi-objective Optimization of a Forest Biomass Supply Chain in Interior British Columbia

Claudia Cambero, PhD Candidate, University of British Columbia, 29-432424 Main Mall, Vancouver, BC, V6J1C6, Canada, cambero.claudia@gmail.com, Taraneh Sowlati

This paper presents a multi-objective optimization model for the design of a forest biomass supply chain for bioenergy/ bioproducts. Objective functions are to maximize NPV, maximize direct jobs and minimize life cycle global warming potential. The ?-constraint method will be used to obtain a set of Pareto optimal solutions deciding on biomass sources; type, size and location of facilities; type and volume of products and; flow of biomass and products within the supply chain.

4 - Biomass Logistics Network Design under Uncertainty and Price Considerations

Gokhan Memisoglu, Texas A&M University, Industrial and Systems Eng. Dept., 3131 TAMU, College Station, TX, 77843, United States of America, gmemis@tamu.edu, Halit Uster

We present a two-stage stochastic program to model a farm-to-biorefinery biomass logistics network. In the first stage, the model determines capacities and locations for collection facilities as well the base biomass price that is offered to farmers. Second stage problem is to determine the transportation decisions and the amount of salvaged or emergency purchased biomass. An efficient solution approach and computational results are provided.

■ MC60

Mezzanine - 100A

Theoretical Data Mining II

Sponsor: Data Mining

Sponsored Session

Chair: Zhongxian Wang, Professor, Montclair State University, Dept. Info & Operations Mgmt, 1 Normal Ave., Montclair, NJ, 07043, United States of America, Professorjohnwang@gmail.com

1 - Regularized Random Forests

Houtao Deng, Intuit, 2632 Marine Way, Mountain View, CA, 94043, United States of America, hdeng3@asu.edu, George Runger

The regularized random forest (RRF) is a collection of trees that avoid using a new feature for splitting a node if its information gain is not significantly greater than the features used in previous nodes. Consequently, an RRF for supervised learning can be used to select a compact subset of features. There are some limitations that can occur when there are a large number of features and few instances at a node (node sparsity issue). A further modified RRF is presented for this case.

2 - Using Interval Predictions for Forecasting

Leonard Wolk, Maastricht University, PO Box 616, Maastricht, Netherlands, l.wolk@maastrichtuniversity.nl, Ronald Peeters

Predicting future events through aggregating information using market mechanisms has been studied extensively. Yet, implementing a market mechanism is not always feasible. In this paper we propose an alternative mechanism to aggregate beliefs about termination times of a stochastic process, by means of point and interval guessing tasks. Our experiment reveals that the Hellinger distance to the true distribution drops by 25% when increasing the aggregation level from two to eight individuals.

■ MC61

Mezzanine - 100B

Data Mining Topics II

Sponsor: Data Mining

Sponsored Session

Chair: Haibing Lu, Assistant Professor, Santa Clara University, 500 El Camino Real, Leavey School of Business, Santa Clara, CA, 95053, United States of America, hlu@scu.edu

1 - Misconfiguration Detection and Resolution in Access Control Systems

Nazia Badar, Rutgers University, 1 Washington Street, Newark, NJ, 07102, United States of America, nbadar@pegasus.rutgers.edu

Protecting data resources against unauthorized accesses is a prime concern for every organization. Implementation of access control system is necessary but not sufficient to ensure best protection of sensitive data. In addition to implementation, correctly configuring the deployed access control system is also a critical factor. We examine this problem and aims to use data mining techniques for addressing this problem.

2 - A Heuristic Algorithm for Rescheduling Problems in Critical Chain Project Management

Yan Zhao, HuaZhong University of Science and Technology, School of Management, LuoYu Road 1073, Wu han, China, zydxd@163.com, Nan fang Cui, Xue jun Hu

This paper focuses on developing a two-step algorithm to solve problems lying in feeding buffer insertion in critical chain project management. First, three priority rules with a dynamic programming are proposed for rescheduling to solve resource conflictions. Then remaining problems of non-critical chain extension and critical chain break are removed by a heuristic algorithm through decreasing feeding buffer size gradually. Finally, a simulation experiment is set up to test the algorithm.

3 - Biased Random-key Genetic Algorithm for Overlapping Correlation Clustering

Carlos Andrade, University of Campinas, Av. Albert Einstein, 1251, Campinas, SP, 13083-852, Brazil, andrade@ic.unicamp.br, Mauricio Resende, Howard Karloff, Flavio Keidi Miyazawa

In Overlapping Correlation Clustering (OCC), a number of objects are assigned to clusters. Two objects in the same cluster have correlated characteristics. As opposed to traditional clustering where objects are assigned to a single cluster, in OCC objects may be assigned to one or more clusters since an object can have characteristics correlated with objects in more than one cluster. In this talk, we present a Biased Random-Key Genetic Algorithm for OCC. Computational experiments are presented.

■ MC62

Mezzanine - 100C

Technometrics Invited Session: Big & Complex Data Problems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Peihua Qiu, University of Florida, Department of Biostatistics, Gainesville, FL, 32611-7450, United States of America, pqiu@phhp.ufl.edu

Co-Chair: Peihua Qiu, Professor, University of Minnesota, Minneapolis, MN, United States of America, qiuxx008@umn.edu

1 - Analysis of Really Big Tables

Matt Taddy, Chicago Booth, University of Chicago, Chicago, IL United States of America, taddy@chicagobooth.edu

When regressing onto a high-dimensional set of explanatory variables, it is often possible to summarize the data in a multi-way contingency table. We can then look at how cell-counts for explanatory variables change with the response, and use the relationship to build scores for predicting future response. We'll discuss adaptive learning and design for a case study on the scoring of Twitter posts for positive, negative, or neutral sentiment directed towards US politicians.

2 - Network-wide Statistical Modeling and Prediction of Computer Traffic

George Michailidis, University of Michigan, 1085 South University Ave., 439 West Hall, Ann Arbor, MI, 48109, United States of America, gmichail@umich.edu

Network engineers are interested in monitoring traffic across all links of their network. However, resource constraints and limited access, makes it impossible to directly measure traffic on all the links. We introduce a physically interpretable, probabilistic model of network-wide traffic that can be used in conjunction with easily obtainable measurements to provide more accurate prediction than is possible with only the inexpensive measurements.

3 - Applying Control Chart Methods to Enhance Data Quality

Allison Jones-Farmer, Auburn University, 420 Lowder Business Building, Auburn, AL, 36849, United States of America, joneall@auburn.edu, Jeremy Ezell, Benjamin Hazen

As the volume and variety of available data grows, organizations turn to analytics to enhance decision-making; however, the decisions are only as good as the data on which they are based. We examine the data quality problem and propose the use of control charting for data quality monitoring and improvement. We include discussions of the data quality dimensions and highlight the lack of appropriate statistical methods for analysis. We suggest opportunities for research within this area.

■ MC63

Mezzanine - 100D

From Data to Decision-Making: A SPC Perspective

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Fadel Megahed, Assistant Professor, Auburn University, 3301L Shelby Center, Auburn, AL, 36849, United States of America, fmegahed@auburn.edu

Co-Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

1 - A Statistical Process Monitoring Perspective on Big Data

Fadel Megahed, Assistant Professor, Auburn University, 3301L Shelby Center, Auburn, AL, 36849, United States of America, fmegahed@auburn.edu, Allison Jones-Farmer

In this paper, we discuss several big data applications to highlight the opportunities and challenges for applied statisticians interested in surveillance and statistical process control. Our goal is to bring the research dialogue into better focus and encourage methodological developments for big data analysis in these areas.

2 - Rank-based Process Control for Mixed-Type Data

Dong Ding, HKUST, HKUST, Hong Kong, Hong Kong - PRC, dding@ust.hk, Fugee Tsung, Jian Li

Conventional control charts focus on either continuous or categorical data monitoring separately. However little literature deals with mixed-type data monitoring when both continuous and categorical observations exist. We utilize ordinal information in the categorical variables and propose an efficient control chart based on standardized ranks. Simulation results show that the proposed chart is effective in detecting location shifts and robust to various distributions.

3 - Broaching Process Monitoring Based on Global and Cyclic Signals

Ran Jin, Virginia Tech, Grado Dept of Industrial and Systems, Engineering, 111 Durham Hall, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Wenmeng Tian, Tingting Huang, Jaime Camelio

Broaching is a machining process to create specific shaped slots. Both global and local defects in manufacturing process may exhibit, while those defects are hard to be detected based on product quality or tool conditions in real practice. In this talk, we present a process monitoring framework for global and local defects based on pulling force signals. Both a simulation and a case study of broaching processes are performed to illustrate the effectiveness of the proposed method.

4 - A Control Chart Integrating Out of Control Data Information for Complex Processes

Chi Zhang, HKUST, Room 607D, Tower A, University Apartment, Kowloon, Hong Kong - PRC, czhangaf@ust.hk, Fugee Tsung

Currently conventional Statistical Process Control methods only make use of in control data. However, as data become easier to store, historical out of control (OC) data are provided and can be exploited as well, especially for processes with less prior information. We propose a general framework to monitor complex processes in which historical OC data are fully utilized and some data mining tools are employed. A simple diagnostic framework could be applied when the control chart signals.

■ MC64

Mezzanine - 100E

Multivariate Data Analysis for Quality and Reliability Improvement II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qingyu Yang, Assistant Professor, Wayne State University, 4815 Fourth Street, Detroit, MI, 48202, United States of America, qyang@wayne.edu

Co-Chair: Li Zeng, Assistant Professor, The University of Texas at Arlington, 500 West First Street, Arlington, TX, 76019, United States of America, lzeng@uta.edu

1 - Phase I Analysis of Optical Profiles in Low-E Glass Manufacturing

Smriti Neogi, Graduate student, The University of Texas at Arlington, 500 West First Street, Arlington, TX, 76019, United States of America, smriti.neogi@mavs.uta.edu, Li Zeng

Low-emittance (low-E) glass manufacturing has become an important sector of the glass industry due to its benefits in energy efficiency. One critical quality characteristic in low-E glass manufacturing processes is optical profiles measured on glass surface. In this study, a hybrid method is proposed for Phase I analysis of such profile data which integrates polynomial modeling, independent component analysis and nonparametric change detection procedures.

2 - Statistical Monitoring of Multiple Binary Data Streams

Devashish Das, Student, University of Wisconsin, Madison, Department of Industrial Engineering, 1513 University Avenue, Madison, WI, 53706, United States of America, ddas3@wisc.edu, Yong Chen, Shiyu Zhou, Cris Sievenpiper

In this research we develop control charts to monitor multi-stream binary data and to do that we develop two kinds of control charts. The first control chart is a log-likelihood ratio based Cumulative Sum (CUSUM) chart for monitoring all the data streams simultaneously. Thus letting us have a system level monitoring scheme. The second kind of control chart is for monitoring individual binary stream. These chart are shown to have better ability to detect changes than traditional Shewhart chart.

3 - Quality Analysis and Prediction Model Based on Multivariate Data Analysis

Yibo Ai, Assistant Professor, USTB, No.30 Xueyuan Road, Haidian District, Beijing, 100083, China, ybai@ustb.edu.cn, Bin Yang

The manufacturing process is a multivariate, complex process. The quality model of predicting and controlling are developed, based on the statistical dataset from the production process of the complex manufacturing process, which include the process control parameters, raw material parameters and the product quality parameters. The report is focused on new methods of quality modeling, prediction and production process control.

4 - Test for Detecting Arbitrarily Shaped Clusters based on Adaptive Minimum Spanning Tree

Ruoyu Zhou, Faculty of Business Administration, University of Macau, A203,Block 1,Faculty of Business, Administration,University of Macau, Macau, amyzhou@umac.mo, Lianjie Shu

Spatial scan statistic is the most popular test in detecting spatial clusters.However,it has low power to detect irregularly shaped clusters due to use of circular scan window.So,more attentions are placed in searching clusters with arbitrarily shapes.In this paper,we give a test inspired by minimum spanning tree(MST).We cut edges of the MST in the process of finding clusters,relying on the smallest validity index.With this method single or multiple clusters of any shapes can be detected.

■ MC65

Mezzanine - 100F

Visions of Social Media Deep Analytics: Beyond Today's Challenges

Cluster: Social Media Analysis

Invited Session

Chair: Captain Dylan Schmorrow, Office of the Assistant Secretary of Defense (Research and Engineering), 4800 Mark Center Drive, Suite 17E08, Alexandria, VA, United States of America, Dylan.Schmorrow@osd.mil

1 - Social Media Deep Analytics: Integration and Evaluation Horizons

Shawn Weil, Director: Analytics, Modeling, & Simulation, Aptima, Inc., 12 Gill St., Suite 1400, WOBURN, MA, 02176, United States of America, sweil@aptima.com, Robert McCormack, Ian Yohai

Contemporary analytic tools provide analysts a macro-level view of events of interest, but often do little more than aggregate and summarize. To enable deep insight, the multi-source social media landscape (photo, video, microblogs) needs to be considered explicitly in the context of traditional data sources.

2 - Social Link Recommendation

Masoud Makrehchi, Associate Professor, University of Ontario, Institute of Technology, 2000 Simcoe Street North, Oshawa, ON, L1H7K4, Canada, Masoud.Makrehchi@uoit.ca

Several strategies for link recommendation and prediction are discussed. First, taxonomy of the topic is presented. Then, social data and features are briefly discussed. Several link prediction methods including (semi)supervised and unsupervised techniques, and also link prediction using hidden topics are detailed. Finally, some applications and examples are outlined.

3 - Event-based Sentiment Analysis for Stock Market Prediction using Social Media

Masoud Makrehchi, Associate Professor, University of Ontario, Institute of Technology, 2000 Simcoe Street North, Oshawa, ON, L1H7K4, Canada, Masoud.Makrehchi@uoit.ca

We extract significant stock movements and collect appropriate pre, post and contemporaneous text from Twitter. Then the respective label for each tweet is assigned. We aggregate the net sentiment per each day and show that it holds significant predictive power for subsequent stock market movement.

4 - Realizing the Vision of Social Radar

Captain Dylan Schmorrow, Office of the Assistant Secretary of Defense (Research and Engineering), 4800 Mark Center Drive, Suite 17E08, Alexandria, VA, United States of America, Dylan.Schmorrow@osd.mil

To meet current and emerging challenges, we need a 'social radar' (integrated capabilities for situation awareness) which include alerting, course of action analysis, and measures of effectiveness). CAPT Schmorrow will describe the needs for a Social Radar, discuss leading technical challenges, and share some early successes realizing the vision.

■ MC66

Mezzanine - 100G

Pricing and Contracting in Digital Economy

Sponsor: Information Systems

Sponsored Session

Chair: Shivendu Shivendu, University of California, Irvine, The Paul Merage School of Business, Irvine, Ca, 92697, United States of America, sshivend@uci.edu

1 - The View from Onshore

Frank MacCrory, Fordham University, 113 W 60th St., New York, NY, 10023, United States of America, fmaccrory@gmail.com, Jason Dedrick, Kenneth Kraemer

Offshoring creates geographically dispersed teams and threatens onshore IT staff. Increased monitoring and withdrawal (absenteeism and turnover) might negate the cost savings from offshore labor. Our theoretical models examine how offshoring affects information asymmetries, specifically team monitoring and withdrawal. We test our models using a 5 year dataset of 5704 IT staff. Absenteeism and turnover are greater on offshoring projects, but modular team design still lowers overall costs.

2 - Patching the Cloud: Impact of SaaS on Patching and Software Defects

Zhe (James) Zhang, UC Irvine, UC Irvine, Irvine, CA, United States of America, zhez1@uci.edu, Vidyanand Choudhary

A key difference between traditional on-premise software and SaaS is that the users are responsible for running traditional software whereas the vendor is responsible for running SaaS software. We examine this change on the vendor's optimal software release time and proportion of software defects to fix. We find that the SaaS vendor releases the software earlier with more defects, and patches fewer defects; and the number of defects after patching is lower than the socially efficient outcome.

3 - An Information Asymmetry Model of Information Technology (IT) Governance

Joseph Vithayathil, Washington State University, 6238 Adobe Circle, Irvine, CA, 92617, United States of America, joev80@gmail.com

This paper proposes an information asymmetry based definition of IT governance. Agency theory is employed in conjunction with organizational theory to develop a conceptual model, and an empirically testable model.

4 - Social Influence and Consumer Behavior: Evidence from an Online Music Community

Yijen Ho, Ph.D. Student, UC - Irvine, SB 318, UC - Irvine, Irvine, CA, 92617, United States of America, hoy1@uci.edu, Sanjeev Dewan, Jui Ramaprasad

We examine social influence in an online music community by exploiting natural experiment data. We find that music consumption decisions are driven by observational learning of popular music choices. However, these effects vanish within a few days of popularity information disclosure. Social network influence is also observed, but it is more through friends' favoring rather than listening behavior. Put together, our results shed light on the impacts of social on consumer behavior on music.

■ MC67

Mezzanine - 100H

Utility Theory: Advances and Applications

Sponsor: Decision Analysis

Sponsored Session

Chair: Ali Abbas, Associate Professor and Director, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61822, United States of America, aliabbas@illinois.edu

1 - The Intersection of Incentives and Utility Theory

Andrea Hupman, PhD Candidate, University of Illinois, 104 S Mathews Ave., 117 Transportation Bldg, Urbana, IL, 61801, United States of America, hupman1@illinois.edu, Ali Abbas

This research investigates the effect of incentive structures on decision making. We explore these effects in the setting of profit maximizing firms by leveraging effective utility functions to derive managerial insights.

2 - Continuous-time Risk-adjusted Martingales

Zhengwei Sun, Post-doctoral Research Associate, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, zsun4@illinois.edu, Ali Abbas, Dharma Kwon

Abbas (2010) introduced the idea of a risk-adjusted martingale. We introduce the notion of a continuous time risk-adjusted martingale, a continuous-time stochastic process whose certainty equivalent at any future time is equal to its magnitude at the present time. We explore several of its applications and ramifications in finance.

3 - Project Management Decisions with Uncertain Targets

Jeffrey Keisler, Professor, University of Massachusetts Boston, Boston, MA, United States of America, jeff.keisler@umb.edu, Robert Bordley

Many decision making methods in project management center on identifying courses of action that are likely to meet specified targets. In practice, such decisions are much more complicated when targets themselves are subject to change. Using target-oriented utility functions can help handle these complications, as will be shown in several examples.

4 - Correcting a Common Problem in using Bayes Rule with Models and Simulations

Robert Bordley, Booz Allen Hamilton, Troy, MI, United States of America, Bordley_Robert@bah.com

Let Y be a possible stochastic function of X. Suppose X is specified by random draws from the prior probability, p(X). The author has seen some individuals integrate p(Y|X) p(X) over all values of X to get the prior probability over Y. But this approach ignores the prior over Y. This paper presents a more appropriate way of computing the posterior probability.

5 - Utility Bayesian Networks

Ali Abbas, Associate Professor and Director, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61822, United States of America, aliabbas@illinois.edu, Sewoong Oh, Zhengwei Sun

We introduce a graphical representation of multiattribute utility functions that represents an expansion order of the multiattribute utility tree (Abbas 2011). The new graph consists of two directed acyclic graphs superimposed: the first represents the utility independence relations and the second represents the boundary independence relations. New rules for arc reversals in utility networks are introduced to facilitate the elicitation process.

■ MC68

Mezzanine - 100I

Combining Point and Interval Forecasts

Sponsor: Decision Analysis

Sponsored Session

Chair: Anil Gaba, Professor of Decision Sciences, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Anil.GABA@insead.edu

1 - The Wisdom of Small Crowds

Jack Soll, Associate Professor of Management, Duke University, The Fuqua School of Business, 100 Fuqua Drive, Durham, NC, 27708, United States of America, jsoll@duke.edu

We examine the "small crowd" strategy for combining point estimates, which ranks judges based on a cue to expertise (e.g., last period's performance) and averages the opinions of the top five. Although the strategy ignores many opinions, it benefits from excluding the worst judges. We analyzed 90 datasets from the domains of economic forecasting and psychology experiments. Compared to other strategies, the small crowd strategy is robust; it performs well across a wide range of environments.

2 - Combining Probability Distributions: A Hierarchical Model of Experts' Information

Ilia Tsetlin, Associate Professor of Decision Sciences, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, ilia.tsetlin@insead.edu, Robert L. Winkler, Anil Gaba

We develop a Bayesian hierarchical model to represent information acquisition by experts who see common information and also private information from distributions with different means. The model is investigated under different assumptions about the amount and balance of common versus private information as well as the experts' interpretation of the information. We discuss implications for issues such as combining distributions and overconfidence.

3 - Combining Subjective Interval Forecasts

Anil Gaba, Professor of Decision Sciences, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Anil.GABA@insead.edu, Robert L. Winkler, Ilia Tsetlin

Subjective assessment of uncertainty often involves interval forecasts. If such interval forecasts are obtained from two or more assessors, combining them into a single interval estimate is a challenging task. We explore various heuristics for combining these interval estimates, using data from analysts predicting future financial quantities. The heuristics are evaluated by scoring rules that trade off sharpness against calibration.

■ MC69

Mezzanine - 100J

Decision Analysis IV: Behavioral Factors

Contributed Session

Chair: Niharika Garud, PhD Candidate, Indian Institute of Management Bangalore, C/O FPM Office, IIM Bangalore Campus, Bannerghatta Road, Bangalore, 560076, India, niharikag08@iimb.ernet.in

1 - Questioning Reciprocity in Pairwise Comparisons. A Case Study
Pedro Linares, Associate Professor, Comillas P. University, Alberto Aguilera 25, Madrid, -, 28015, Spain, pedro.linares@upcomillas.es, Sara Lumbreras, Alberto Santamaria, Andrea Veiga

Decision makers usually display inconsistencies when expressing their preferences, which are regarded as undesirable and are usually removed. This study attempts to analyze the role of reciprocity in pairwise comparisons. Our experiment shows that decision makers show substantial levels of irreciprocity and inconsistency, and that they may prefer results in which this irreciprocity has not been removed. Our major conclusion is that imposing reciprocity to preferences may not be justified.

2 - When do People Prefer Less Decision Alternatives?
Jae-Hyeon Ahn, Professor, KAIST Business School, 85 Hoegiro, Dongdaemun-Gu, Seoul, Korea, Republic of, jahn@business.kaist.ac.kr, Yoon Soo Bae

More alternatives are better in theory. However, people prefer less in some situations. Through an experiment in the e-commerce setting, we analyzed the levels of satisfaction and regret after customers' purchasing decisions and found out that they vary depending on the number of alternatives.

3 - RFID Implementation Opportunities in Fire Safety Management: Lessons from Twenty Fire Cases
Cui Ligang, Huazhong University of Science & Technology; City University of HongKong, Tat Chee Avenue, Kowloon, Hong Kong SAR, No.1037, Luoyu Road, Wuhan, PR China, HongKong, Hong Kong - PRC, cuiligangdj@gmail.com, Andrew Lim

This paper studied fire cases to discover the radio frequency identification (RFID) implementation opportunities in the fire safety management. Firstly, fire management flow is divided into many processes; secondly, twenty fires are collected and their causes are matched with different management processes; thirdly, RFID implementation opportunities are presented over these fire details. An introduction of a UHF RFID fire inspection platform and our future work are presented at last.

■ MC70

Mezzanine -101A

Airport/Airline Operations Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Ahmed Ghoniem, University of Massachusetts-Amherst, 121 Presidents Drive, Office # SOM 317, Amherst, MA, 01003, United States of America, aghoniem@isenberg.umass.edu

1 - Solving a Large Scale Integrated Airline Planning Problem
Melda Ormeci, Ozyegin University, Cekmekoy, Istanbul, Turkey, melda.ormeci@ozyegin.edu.tr, Gunes Erdogan, Mohamed Haouari, Okan Orsan Ozener

Airline planning problems are considered to be very challenging problems and typically are solved sequentially. In the literature attempts have been made to integrate different stages of these planning problems. We address the integrated fleet assignment and crew pairing problem based on representative data of a European Airline. This problem has its specific properties (e.g. fixed crew salaries, single base, properties of flight schedule). We develop heuristic based novel solution methods.

2 - Solving Multiple-runway Aircraft Sequencing Problems using Column Generation
Farbod Farhadi, University of Massachusetts Amherst, 121 Presidents Dr, Room 230, Amherst, MA, 01003, United States of America, ffarhadi@som.umass.edu, Ahmed Ghoniem

We address mixed mode multiple-runway aircraft sequencing problems using a column generation approach. The pricing sub-problem is solved using dynamic programming and the approach is enhanced using acceleration features. Computational results are reported and discussed.

3 - Lower Cost Arrival Operations under Optimized Profile Descent
Senay Solak, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, solak@isenberg.umass.edu, Heng Chen

We utilize a stochastic framework and derive optimal decision rules for sequencing and spacing flights during optimized profile descent operations. We further conclude that the expected annual savings can be around $29 million if such rules are adapted by the top ten major airports in the U.S. Of these savings, $24 million are expected to be direct savings for airlines due to reduced fuel usage, corresponding to a potential savings of 10-15% in fuel consumption over the current practice.

4 - A Robust Genetic Algorithm for Aircraft Sequencing Over Multiple Runways
Mohamed Kharbeche, Qatar University, Mechanical and Industrial Engineering, Qatar University, Doha, 2713, Qatar, mkharbec@qu.edu.qa, Ameer Al-Salem, Ahmed Ghoniem, Hanif D. Sherali

We propose an effective genetic algorithm for arrival-departure aircraft sequencing problems over multiple runways using linear and non-linear objectives. The proposed algorithm solves large benchmark instances to optimality and near-optimality within reasonable CPU times.

■ MC71

Mezzanine -101B

Aviation Safety Management System (SMS): Modeling and Applications

Sponsor: Aviation Applications

Sponsored Session

Chair: Yoonjin Yoon, Assistant Professor, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, 305-701, Korea, Republic of, yoonjin@kaist.ac.kr

1 - Application of Bayesian Network for Hazard-based Risk Modeling in Aviation Safety Management System
Ohhoon Kwon, graduate student, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseo, Daejeon, 305-701, Korea, Republic of, ohunkwon@kaist.ac.kr, Yoonjin Yoon

Risk modeling is the key to achieve proactive aviation safety management. This study presents application of Bayesian network for hazard-based risk modeling. Bayesian network constructed from historical aviation safety data identifies the relationship among hazards, occurrences, and consequences and provides the conditional probabilities. The model can assess risks that potentially result in accidents or incidents given hazards, or in reverse, identify hazards given occurrences or consequences.

2 - Occurrence in Aviation Safety Management of South Korea: Survey on Various Occurrence Categories
Yunah Noh, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, ynnoh@kaist.ac.kr, Yoonjin Yoon

Successful implementation of the aviation Safety Management System (SMS) highly depends on well-defined set of occurrences which provides important foundation for key SMS tasks. It is commonly agreed that variations in the occurrence definition among organizations hinders integrative and effective implementation of SMS even at the national level. In this paper, we present detailed analysis on commonality and differences in several existing occurrence sets from various organizations.

3 - Addressing Safety Efforts in Management and Oversight of Interdependent Systems of Systems
David Wichner, Associate, Booz Allen Hamilton, 528 Stannage Ave., Albany, CA, 94706, United States of America, davidwichner@gmail.com

Organizational factors have been identified as a significant source of risk for decades. Yet even with the accumulated lessons learned, few solutions have been designed to help make systems of systems more comprehensible. What are the continuing and elusive challenges in achieving higher levels of aviation safety and reliability in the face of the current, excellent safety record? What are some possible solutions to provide 'sense-making' tools for those who manage risk across an industry?

4 - Hazard Risk Assessment in Aviation: Methodology and Case Study Based on NTSB Accident/incident Data
Eunhye Kim, KAIST, Guseong-dong, Daejeon, Korea, Republic of, color845@kaist.ac.kr, Yoonjin Yoon

Hazardous aviation accidents are usually infrequent but are potentially catastrophic, needing proactive control measures against hazards. The guideline to perform adequate risk mitigation measures on these identified potential hazards comes from the hazard risk management, which can be quantified on the basis of historical data. In this study, we propose a methodology for risk assessment and analyze the result using NTSB aviation accident/incident database.

■ MC72

Mezzanine -101C

Risk Management and Quantitative Finance

Cluster: Risk Management

Invited Session

Chair: Ning Cai, Assistant Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, ningcai@ust.hk

1 - Characterization of Optimal Strategy for Multi Asset Investment/Consumption with Transaction Costs

Min Dai, Associate Professor, National University of Singapore, Department of Mathematics, Singapore, Singapore, matdm@nus.edu.sg, Xinfu Chen

We consider the optimal consumption and investment with transaction costs on multiple assets, where the prices of risky assets jointly follow a multi-dimensional geometric Brownian motion. We characterize the optimal investment strategy and in particular show that the trading region has the shape that is very much needed for well defining the trading strategy, e.g., the no-trading region has distinct corners.

2 - Energy Infrastructure Investment over Finite Horizon

Zhen Liu, Assistant Professor, University of Minnesota at Twin Cities, 206 Church St., S.E., Minneapolis, MN, 55455, United States of America, zhenliu@umn.edu

We study the optimal time to construct a green plant of a firm with a portfolio of plants to maximize the expected profit. We formulate the problem as a mixed optimal stopping/control problem, and characterize the optimal strategies through numerical method.

3 - Pricing Both Continuous and Discrete Asian Options under Markov Processes

Ning Cai, Assistant Professor, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, ningcai@ust.hk, Yingda Song, Steven Kou

We derive analytical approximations to both continuous and discrete Asian option prices under general Markov processes. The convergences are justified rigorously. Numerical results illustrate that our pricing methods are accurate and fast under diffusion models, jump diffusion models, and pure jump models.

4 - A New 10-30 Rule: An Investigation of Hedge Fund Performance Fees via Behavioral Finance

Steven Kou, Professor, Columbia University, 801C Schapiro CEPSR, New York, United States of America, sk75@columbia.edu, Xuedong He

A main cause of the recent financial crisis is excessive risk taking due to the limited liability of fund managers and corporations. We show that in most cases it is possible to improve the satisfaction of regulators, fund managers, and fund investors simultaneously by replacing the traditional 20% performance fee scheme with a new 10-30 first-loss scheme, in which fund managers take 30% performance fee in return for their 10% first-loss capital investment.

Monday, 4:30pm - 6:00pm

■ MD02

Level 2 - Room 200B

Topics in Approximate Dynamic Programming

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Angelo Mancini, PhD Student, University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, amancini@chicagobooth.edu

1 - Approximate Dynamic Programming for Distributed Grid-level Storage: A Case Study of the PJM Grid

Daniel Salas, Princeton University, Chemical & Biological Engineering, Princeton, NJ, 08540, United States of America, dsalas@princeton.edu, Hugo Simão, Warren Powell

We present an application of approximate dynamic programming for the control of grid-level energy storage distributed across the electricity grid, under uncertainty in wind power generation and grid congestion. Our case study is based on the PJM grid, which has over 9,000 buses and 14,000 transmission lines. We analyze the spatiotemporal patterns of storage in the presence of grid congestion, as well as the impact of using mixed storage portfolios of different efficiencies and capacities.

2 - Efficient Reinforcement Learning with Compact Value Function Approximations

Zheng Wen, Stanford University, 274 Packard, Stanford, United States of America, zhengwen@stanford.edu, Benjamin Van Roy

We provide a provably efficient RL algorithm for large-scale RL problems with compact Q-function approximations. Our proposed RL algorithm is both sample efficient and computationally efficient. The main idea of our algorithm is to choose actions based on "optimism in the face of uncertainty" to hit a right balance between efficient exploration and efficient exploitation.

3 - Power Approximations in Network Revenue Management

Dan Adelman, Professor of Operations Management, University of Chicago, Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, dan.adelman@chicagobooth.edu, Christiane Barz, Canan Uckun

We consider a new approximation architecture for the network revenue management problem using power functions to express concavity. We address a number of technical challenges in fitting parameters and demonstrate numerical performance compared against other approximations.

4 - Dynamic Software Release Management

Angelo Mancini, PhD Student, University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, amancini@chicagobooth.edu, Dan Adelman

Software release management is the process by which firms decide on the timing and composition of future releases. We establish conditions under which the firm can use a modified discount factor to model the impact of a stochastically improving competitor. We then formulate the problem as a semi-Markov decision process, and identify a scenario for which the optimal policy is open loop. Finally, we apply approximate dynamic programming to construct several high-performing policies.

■ MD03

Level 2 - Room 200C

Reformulations and Convex Underestimators in Global Optimization

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Andreas Lundell, Post Doctoral Researcher, bo Akademi University, Biskopsgatan 8, Turku, 20500, Finland, andreas.lundell@abo.fi

1 - Optimality-based Bound Contraction using Multiparametric Disaggregation

Pedro Castro, LNEG, Estrada Paço Lumiar 22, Lisbon, Portugal, pedro.castro@lneg.pt, Ignacio E. Grossmann

We consider non-convex mixed-integer bilinear programs (MINLP) and propose to use multiparametric disaggregation relaxations for optimality bound contraction. This allows us to further reduce the domain of the variables when compared to the traditional way of using McCormick envelopes. Taking the short-term scheduling problem of hydro power systems as a case study, we show that smaller optimality gaps can be achieved than those from commercial global solvers given the same computational time.

2 - Reformulation Based Global Optimization of Nonconvex MINLP Problems

Andreas Lundell, Post Doc Researcher, Abo Akademi University, Biskopsgatan 8, TURKU, 20500, Finland, andreas.lundell@abo.fi, Tapio Westerlund

In this presentation, a method for solving nonconvex MINLP problems is described. Instead of applying a branch-and-bound strategy, reformulation techniques are utilized to obtain convex overestimations of nonconvex problems in an extended variable-space. A sequence of these problems is solved to obtain the global solution. For nonconvex twice-differentiable functions, a quadratic spline underestimator is used. The result is an easily-implementable algorithm solving a very general problem class.

3 - A Cutting Plane Algorithm for Convex Generalized Disjunctive Programming Models

Francisco Trespalacios, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ftrespal@andrew.cmu.edu, Ignacio E. Grossmann

GDP problems are can be reformulated as MILP/MINLP models using either Big-M (BM) or hull reformulation (HR). The former yields a smaller problem while the later a tighter one. The tightness of (HR) can be further improved by using basic steps. In this work we propose a cutting plane algorithm for convex GDP that exploits the advantages of (BM), (HR) and basic steps. We solve the continuous relaxation of the (BM), and use the strong formulation of (HR) after basic steps to derive cutting planes.

■ MD04

Level 2 - Room 200D

Mixed-Integer Programming: Cutting Planes and Models

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Ismael de Farias, Texas Tech, Box 43103, Lubbock, TX, 79409-3103, United States of America, ismael.de-farias@ttu.edu

1 - Polyhedral Results for Network Interdiction Problem

Danial Davarnia, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, d.davarnia@ufl.edu, Jean-Philippe Richard, Mohit Tawarmalani

We study a relaxation of the KKT system that occurs when reformulating network interdiction problems as mathematical programs. This set has both complementarity constraints and binary variables. We describe a procedure to derive the convex hull of this set when a single complementarity constraint is present. We then use this result to obtain a closed-form description of the convex hull of special cases, including one with two complementarity constraints. We conclude with computational results.

2 - Improving the Integer L-shaped Method

Gustavo Angulo, Georgia Tech, Atlanta, GA, United States of America, gangulo@gatech.edu, Shabbir Ahmed, Santanu Dey

We consider the integer L-shaped method for two-stage stochastic integer programs. To improve the performance of the algorithm, we devise a simple modification that alternates between linear and mixed-integer subproblems, yielding significant time savings. We also present a general framework to generate optimality cuts via a cut-generating problem which considers information from all solutions found so far at any given stage of the method.

3 - A Polyhedral Study of the Unit Commitment Problem with Ramping Constraints

Pelin Damci-Kurt, The Ohio State University, Dept. of Integrated Systems Eng., 210 Baker Systems Building 1971 Neil Ave., Columbus, OH, 43210, United States of America, damci-kurt.1@osu.edu, Alper Atamturk, Deepak Rajan, Simge Küçükyavuz

We study a unit commitment problem in which the goal is to minimize the operational cost of power generators over a finite horizon subject to physical constraints. In particular, we consider a relaxation involving the ramping constraints. We present several classes of facet-defining inequalities, describe the convex-hull for the two-period case, and report our computational experiments with using the multi-period inequalities in a branch-and-cut algorithm.

■ MD05

Level 2 - Room 200E

Survivable Network Design and Its Applications

Sponsor: Optimization/Networks

Sponsored Session

Chair: Neng Fan, Assistant Professor, University of Arizona, Tucson, AZ, 85721, United States of America, nfan@email.arizona.edu

1 - Resilient Network Design via Chance Constrained Spanning K-cores

Juan Ma, Ph.D. Student, Oklahoma State University, 26 N University Place Apt. 8, Stillwater, OK, 74075, United States of America, juan.ma@okstate.edu, Baski Balasundaram

Given a non-negative integer k, a graph of minimum degree at least k is called a k-core. The concept of k-cores can be used to design resilient networks that preserve low diameter and high vertex-connectivity upon vertex and/or edge failures. This talk focuses on a chance-constrained version of the minimum spanning k-core problem under probabilistic edge failures, and we discuss decomposition algorithms to solve this problem.

2 - On the Network Design Problem with Mixed Connectivity Requirements

Elham Sadeghi, University of Arizona, 1127 E. James E. Rogers Way, Rm 111, Tucson, United States of America, sadeghi@email.arizona.edu, Neng Fan

In this talk, we present and prove several equivalent theorems to ensure a minimum-cost network to be (K,l)-connected. A graph is (k,l)-connected if removal of certain numbers (related to k,l) of vertices and edges will not disconnect the graph. Based on these theorems, we present formulations and algorithms to solve the minimum-cost network design problem.

3 - Towards the Dominating Set Edge Blocker Problem

Jose L. Walteros, University of Florida, 303 Weil Hall, Gainesville, FL, 32608, United States of America, jwalteros@ufl.edu, Vladimir Boginski, Panos Pardalos, Foad Mahdavi Pajouh

We study the problem of removing a subset of edges of minimum cardinality, such that the weight of any dominating set in the remaining graph is bounded below by a given constant r. This problem can be seen as a generalization of the minimum bondage set problem and is motivated from the practical need of evaluating robustness and vulnerability of any given graph in terms of preserving the weight of the dominating sets while its edges are being removed.

4 - Solutions for Two-stage Robust Optimization

Long Zhao, University of South Florida, 4202 East Fowler Avenue, ENC2400, Tampa, FL, 33620, United States of America, longzhao@mail.usf.edu, Bo Zeng

In this talk, we propose new solution methods for solving two-stage robust optimization.

■ MD06

Level 2 - Room 200F

Network Optimization

Sponsor: Optimization/Networks

Sponsored Session

Chair: Sangho Shim, Research Associate, Kellogg School of Management/Northwestern University, 2001 Sheridan Road, Suite 548, Evanston, IL, 60208, United States of America, shim@northwestern.edu

1 - Data Aggregation Method for A Covering Problem with Gradual Coverage

Hoon Jang, KAIST, 335 Gwahangno, Yuseong gu, Daejeon, Korea, Republic of, hoon.jang@kaist.ac.kr, Taesik Lee

We study a data aggregation method for covering location problem. There exists an aggregation method that reduces data without causing errors. It was developed for covering problem with 0-1 type coverage, and we generalize the method to apply to gradual coverage covering problem. We approximate a gradual coverage function into a step-wise function using K-means algorithm, and a common reachability set is constructed accordingly. Experimental results show the effectiveness of the proposed method.

2 - A Framework to Determine Critical Links of an Intercity Rail Network for Pre-disaster Infrastructure

Yoonjin Yoon, Assistant Professor, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, 305-701, Korea, Republic of, yoonjin@kaist.ac.kr

In the study, an existing tree-search algorithm to efficiently enumerate potential network states is extended to the Link-based Categorization of Network States (LCNS). This procedure categorizes each newly enumerated network state depending on its coincidence with any specific link's degradation.
A computational experiment was conducted on a real-world intercity rail network, which reveals that proposed method effectively determines critical links, particularly for disastrous scenarios.

3 - The Facets of the Tree Partition Problem

Sangho Shim, Research Associate, Kellogg School of Management/Northwestern University, 2001 Sheridan Road, Suite 548, Evanston, IL, 60208, United States of America, shim@northwestern.edu, Dabeen Lee, Sunil Chopra

We identify the facets and a minimal representation of the tree partition problem. We develop a linear time separation algorithm to identify the most violated one among the exponentially many facets.

4 - Two Dimensional Load Balancing

Kangbok Lee, Research Associate Professor, Rutgers University, Business School, Piscataway, NJ, United States of America, kangblee@business.rutgers.edu, Joseph Leung, Michael Pinedo

We consider a bi-criteria parallel machine scheduling problem in which the first objective is to minimize the makespan of the schedule and the second objective is to minimize the maximum machine cost. Since the problem is strongly NP-hard, we propose a fast heuristic and derive its worst-case performance bound.

■ MD07

Level 2 - Room 200G

Learning and Computation for Stochastic Optimization and Variational Problems

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Uday Shanbhag, Pennsylvania State University, 353 Leonhard Building, University Park, PA, 16802, United States of America, udaybag@engr.psu.edu

1 - A Stochastic Trust Region Algorithm for Mixed Logit Type Problems

Anton Kleywegt, Associate Professor, ISyE - Georgia Tech, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, anton@isye.gatech.edu, Xinchang Wang

We consider mixed logit problems involving a high dimensional integral for each observation in the data set. We propose a trust region type algorithm that separately controls the sample size for each observation's Monte Carlo integral. In addition, the algorithm controls sampling from the data set. We provide sufficient conditions for convergence, and demonstrate the algorithm with numerical results for the estimation of mixed logit discrete choice models, using data from a busy airline market.

2 - A Regularized Smoothing Stochastic Approximation Algorithm for Stochastic Variational Inequalities

Farzad Yousefian, University of Illinois Urbana-Champaign, Dept. of Industrial & Systems Eng, 104 S Mathews Ave., Urbana, 61801, United States of America, yousefi1@illinois.edu, Uday Shanbhag, Angelia Nedich

We consider a stochastic variational inequality problem with a monotone mapping over a compact and convex set and present a regularized smoothed stochastic approximation scheme wherein stepsize, smoothing, and regularization parameters are updated iteratively. Under suitable assumptions, we show the convergence in an almost-sure sense. Rate estimates that relate iterates to their counterparts derived from the Tikhonov trajectory associated with a deterministic problem are also provided.

3 - Ambiguity in Risk Preferences in Optimization and Control

William Haskell, Visiting Assistant Professor, University of Southern California, 3715 McClintock Avenue, Los Angeles, United States of America, wbhaskell@gmail.com, Rahul Jain, Z. Max Shen, J. George Shanthikumar

We discuss the problem of ambiguity in risk preferences and its relation to stochastic dominance. We review work on stochastic dominance constrained optimization, and then we present new material on multivariate stochastic dominance constrained optimization. Next, we show how to place stochastic dominance constraints on the distribution of reward in Markov decision processes. We conclude the presentation by arguing for the worth of a measure of regret based on stochastic dominance.

4 - On the Solution of Stochastic Optimization Problems in Imperfect Information Regimes

Uday Shanbhag, Pennsylvania State University, 353 Leonhard Building, University Park, PA, 16802, United States of America, udaybag@engr.psu.edu, Hao Jiang

We consider the solution of a parametrized stochastic convex optimization problem in regimes where the prescribed parameter is unavailable. Instead, it may be learnt by minimizing a suitable expected-value metric. We present a coupled stochastic approximation scheme for computing the solution and learning the unknown parameter. Almost-sure convergence statements and rate estimates are provided in strongly convex as well as a merely convex regimes.

■ MD08

Level 2 - Room 200H

Modeling Systems II

Sponsor: Computing Society

Sponsored Session

Chair: Paul Rubin, Professor Emeritus, Michigan State University, 426 Auditorium Rd., East Lansing, MI, 48824-1046, United States of America, rubin@msu.edu

1 - Recent Developments in Coopr

John Siirola, Sandia National Laboratories, Albuquerque, NM, United States of America, jdsiiro@sandia.gov, William E. Hart, Jean-Paul Watson

In this presentation we highlight recent developments in the Coopr project, including new language constructs, support for differential-algebraic systems, and support for solver callbacks. Coopr is an open-source umbrella project for supporting optimization within Python. It includes the Pyomo modeling environment and several extensions, including support for stochastic programming (PySP), differential-algebraic systems (DAE), and disjunctive programming (GDP).

2 - Dip and DipPy: A Decomposition-based Modeling System and Solver

Ted Ralphs, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, ted@lehigh.edu, Matthew Galati, Michael O'Sullivan, Jiadong Wang

DIP is a framework for implementing decomposition-based algorithms for solving mixed-integer linear programs. The latest release includes a Python-based modeling language and a fully generic decomposition-based solver that the user can customize with callbacks for cut and column generation written in Python. We review the framework and give computational results on a variety of instances solved in parallel on a multi-core architecture.

3 - Connecting Algebraic Modeling Languages to Solvers

Horand Gassmann, Professor, Dalhousie University, 6100 University Ave., Halifax, NS, Canada, Horand.Gassmann@dal.ca, Kipp Martin, Jun Ma

Loosely coupled systems in mathematical optimization allow easy substitution of one solver for another. However, solver options are often specific to one solver, and syntax and interpretation may differ. Optimization Services is a web-aware framework providing a common interface between algebraic modeling languages (AMLs) and several open-source and commercial solvers. This talk describes the methods we used to overcome the difficulties encountered in connecting these solvers to a common AML.

4 - SolverStudio: A Free Integrated Excel Environment for Optimization using Modelling Languages

Andrew Mason, Senior Lecturer, University of Auckland, Private Bag 92019, Auckland, New Zealand, a.mason@auckland.ac.nz

Excel's widespread use makes it an ideal tool for teaching and delivering optimization models. However, serious modellers often prefer to use modelling languages such as AMPL, GAMS, PuLP or COOPR/Pyomo. SolverStudio integrates these two worlds by allowing optimization models to be easily developed and solved in Excel. Available free from http://solverstudio.org, SolverStudio also includes support for Python-based Gurobi models, the SimPy simulation environment, and cloud-based solving via NEOS.

■ MD09

Level 2 - Room 200I

Challenges and Opportunities in Healthcare Analytics

Sponsor: Analytics Section

Sponsored Session

Chair: Don Kleinmuntz, Chief Analytics Officer, Strata Decision Technology, 200 E Randolph St., 49th Floor, Chicago, IL, 60654, United States of America, DNK@stratadecision.com

1 - Hospital Business Analytics in an Era of Healthcare Reform

Don Kleinmuntz, Chief Analytics Officer, Strata Decision Technology, 200 E Randolph St., 49th Floor, Chicago, IL, 60654, United States of America, DNK@stratadecision.com

Reform is transforming U.S. hospitals & health systems. Analytics can help, but this requires careful balance of clinical, operational, and financial objectives, and massive investment in IT. This presentation draws on years of experience with financial decision making in hospitals and health systems to illustrate the opportunities and challenges, discussing applications of descriptive, predictive, and prescriptive analytics.

2 - A Framework for Data-driven Improvement of Healthcare

Juergen Klenk, Principal, Booz Allen Hamilton, Inc., 8283 Greensboro Drive, McLean, VA, 22102, United States of America, klenk_juergen@bah.com

According to Erik Brynjolfsson of MIT's Sloan School of Management, "The problem is not that we don't have enough data – it's that we have too much data and we need to make sense of it." In this presentation we will review a framework to generate value from data in Healthcare. We will illustrate its usability with a case study on mining EHRs to reduce hospital-acquired conditions such as sepsis, and close with additional examples on how Analytics can drive improvement of our Healthcare system.

■ MD10

Level 2 - Room 200J

Panel Session: Managing Successful Careers in O.R. Practice - A Panel Discussion

Sponsor: CPMS, The Practice Section

Sponsored Session

Chair: J. Antonio Carbajal, Turner Broadcasting System, Inc., 1050 Techwood Drive N.W., Atlanta, GA, United States of America, Antonio.Carbajal@turner.com

1 - Managing Successful Careers in O.R. Practice - A Panel Discussion

Moderator: J. Antonio Carbajal, Turner Broadcasting System, Inc., 1050 Techwood Drive N.W., Atlanta, GA, United States of America, Antonio.Carbajal@turner.com, Panelists: Doug Samuelson, Pooja Dewan, Allen Butler, Radhika Kulkarni

This panel brings together seasoned O.R. practitioners from different industries to discuss common challenges and strategies for managing a successful career in O.R.

■ MD11

Level 2 - Room 201A

Panel Session: 10 Habits of a Successful Assistant Professor

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Esra Buyuktahtakin, Assistant Professor, Wichita State University, 1845 Fairmount St., Wichita, NE 67260, United States of America, Esra.Buyuktahtakin@wichita.edu

1 - 10 Habits of a Successful Assistant Professor

Moderator: Esra Buyuktahtakin, Assistant Professor, Wichita State University, 1845 Fairmount St., Wichita, NE 67260, United States of America, Esra.Buyuktahtakin@wichita.edu, Panelists: Wedad Elmaghraby, Ronald Askin, Jane Ammons, J. Cole Smith

In this discussion, panelists from engineering and business departments will share several good and bad habits that can affect the success of a tenure track assistant professor. Panelists have experiences in winning many prestigious awards, getting federal and industrial grants, and publishing in reputable journals. Not only they are successful in their career but also they have mentored many academicians and helped them become successful in their academic careers. They will also share interesting stories based on their experiences, which would teach important lessons to junior faculty.

2 - Good and Bad Habits for New (and Not so New) Faculty

Moderator: J. Cole Smith, Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, cole@ise.ufl.edu, Panelists: Jane Ammons, Ronald Askin, Wedad Elmaghraby, Esra Buyuktahtakin

I will discuss several habits that my colleagues and I use to make our experience as a professor more enjoyable, successful, and rewarding. The presentation will focus on how core principles drive good habits. Because some good habits are, essentially, not falling into bad habits, I will discuss some common ones through cautionary tales (augmented by my own experience). The panel will solicit feedback and discussion in lieu of a long presentation.

■ MD12

Level 2 - Room 201B

SpORts - Scheduling and Alignment

Sponsor: SpORts

Sponsored Session

Chair: Keith Willoughby, University of Saskatchewan, 25 Campus Drive, Saskatoon, Canada, willoughby@edwards.usask.ca

1 - Combining Optimization and Metaheuristics to Schedule Major League Baseball Umpires

Michael Trick, Professor, Tepper School, Carnegie Mellon, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, trick@cmu.edu

The average Major League Baseball umpire will handle more than 140 games over a 182 day season, traveling more than 30,000 miles. There are a host of conflicting objectives and constraints that makes finding a suitable schedule a difficult process. I will outline ways that optimization and metaheuristic approaches can work together to find playable schedules.

2 - Scheduling the Brazilian Soccer Tournament: Solution Approach and Practice

Celso Ribeiro, Universidade Federal Fluminense, Niteròi, 22410-240, Brazil, celso@ic.uff.br, Sebastian Urrutia

The Brazilian soccer tournament is a compact, mirrored double round-robin tournament played by 20 teams in each of its two divisions. It is possibly the world's most attractive soccer tournament. Devising optimal schedules is crucial to players, teams, fans, sponsors, and administrators. Fair and balanced schedules are a major issue. We describe the problem formulation and its solution approach. We also report on the practical experience gathered after scheduling the tournament for three years.

3 - Informing Footbal Schedule Creation through Alternative Objective Functions

Keith Willoughby, University of Saskatchewan, 25 Campus Drive, Saskatoon, Canada, willoughby@edwards.usask.ca, Kent Kostuk

The 8-team Canadian Football League (CFL) features an 18-game regular season played between late June and early November. We report on our experiences with the CFL in creating optimization models to inform schedule development. Using particular objective functions to create various schedules has enhanced our communication with the CFL and enabled league officials to better understand how analytical modeling enlightens practice.

4 - Multi-objective Optimization of Sports League Alignments

Stephen Hill, Assistant Professor, UNC Wilmington, 601 South College Rd., Wilmington, NC, 28403, United States of America, Hills@uncw.edu

Traditionally the development of sports league alignments has been driven by the placement of teams into divisions based on geographic proximity. However, such an approach can lead to leagues with divisions that feature poor competitive balance. In this work divisional competitive balance is incorporated into the optimal development of sports league alignments. Results from the National Basketball Association and the National Hockey League are presented and analyzed.

■ MD13

Level 2 - Room 202A

Innovation with Crowds II

Cluster: New Product Development

Invited Session

Chair: Joel Wooten, University of South Carolina, Moore School of Business, Columbia, SC, United States of America, joel.wooten@moore.sc.edu

1 - Innovation Tournaments with Multiple Contributors

Ersin Korpeoglu, Carnegie Mellon University Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, United States of America, ekorpeog@andrew.cmu.edu, Soo-Haeng Cho, Laurence Ales

We study an innovation tournament in which an organizer seeks multiple solutions from agents. While agents exert efforts to improve solutions, their outcomes face technical uncertainty and subjective taste of the organizer. For a large class of distributions, we show a winner-takes-all award scheme is optimal. As participants increase, agents do not necessarily reduce their efforts, and the organizer need not always increase the award. We compare the tournament with individual contracts.

2 - Does Feedback Matter in Crowdsourcing Contests? Theoretical and Empirical Evidences

Jiahui Mo, Ph.D, University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, 75080, United States of America, jiahui.mo@utdallas.edu

In crowdsourcing contests, a seeker often provides performance feedbacks to solvers. A central problem in crowdsourcing contest is whether feedback matters and how feedback influences solvers' incentives in crowdsourcing contest. This paper builds a theoritical model to investigates the relationship between seeker feedback and solver behavior. Towards the end, using a unique dataset of an online crowdsourcing contest site in China from 2007 to 2010, we empirically test the relationship.

3 - Ambitious Goals and Stretched Resource Allocation: Managerial Biases under Innovation Uncertainty

Jaime Andrés Castañeda, Universita della Svizzera Italiana (USI, Lugano), Via Giuseppe Buffi 13, Lugano, 6904, Switzerland, castanej@usi.ch, Nitin Joglekar, Paulo Gonçalves

We develop a stylized decision model based on the Newsvendor problem that incorporates the possibility of either setting ambitious design targets or stretched resource allocations goals. Experimental tests show that decision makers tend to overreact/underreact when costs and uncertainty call for less/more resources or ambitious scopes (pull-to-center effect) and to chase uncertainty thresholds realized in prior innovation efforts (threshold chasing), resembling common inventory-ordering biases.

4 - The Impact of Visibility in Innovation Tournaments
Joel Wooten, University of South Carolina, Moore School of Business, Columbia, SC, United States of America, joel.wooten@moore.sc.edu

In innovation tournaments, administrators face a variety of decisions that impact the outcome. We examine the effect of submission transparency on idea quality and uniqueness by comparing blind and unblind contests using field experiments.

■ MD14

Level 2 - Room 202B

Supply Chain: Disruption Management

Contributed Session

Chair: Ruoxuan Wang, PhD candidate, University of Florida, 361F STZ, PO BOX 117169, Gainesville, FL, 32603, United States of America, rxwang@ufl.edu

1 - A Scenario Based Optimization of Resilient Supply Chain with Dynamic Fortification Cost
Amirhossein Meisami, Student, Texas A&M University, Texas A&M University, College Station, TX, United States of America, meisami@neo.tamu.edu, Akshat Dimri

Considering all possible disruption scenarios, the developed model looks for the most efficient solution to allocate the fortification budget and emergency inventory while minimizing the expected shortage costs. The reliability of each supplier depends on the assigned fortification budget and varies from no reliability to fully reliable. As the reliability of the supplier increases the fortification cost to improve its level of reliability will grow dynamically.

2 - Modeling the Effects of Disruption on Gasoline Supply Chain
Yasaman Kazemi, North Dakota State University, NDSU Dept. 2880, PO Box 6050, Fargo, ND, 58108, United States of America, yasaman.kazemi@ndsu.edu, Joseph Szmerekovsky

Since petroleum supply chains are complex, lengthy and interdependent, disruption may become a serious challenge to the efficiency and reliability of the whole energy system. This study develops a Stochastic Mixed Integer Linear Programming (SMILP) model for the gasoline supply chain to hedge against facility disruptions and to minimize the expected total cost of location and transportation of gasoline in the downstream oil supply chain.

3 - Procurement Options Contract under Breach and Renegotiation
Xiao Wen, PhD Candidate, The Chinese University of Hong Kong, Rm. 802, William Mong Engieering BLDG., Shatin, Hong Kong - PRC, xwen@se.cuhk.edu.hk, Ozgun Demirag, Chun-Hung Cheng

We consider an options contract between a supplier and a manufacturer in the presence of a spot market. The contract is designed based on a two-stage Stackelberg game and incorporates events such as supplier's breach of contract (with or without an abandonment fee) and price renegotiation. We derive analytical results on the contract parameters and evaluate the contract efficiency in coordinating the supply chain.

4 - Outsourcing for Power Disruption
Ruoxuan Wang, PhD candidate, University of Florida, 361F STZ, PO Box 117169, Gainesville, FL, 32603, United States of America, rxwang@ufl.edu, Janice Carrillo

In the event of a large scale power disruption, many manufacturers are now outsourcing to a third party supplier. We model different types of contracts between a manufacturer and a supplier in the event of a disruption utilizing options contracts and game theory methodologies.We develop theoretical results which show the specific mechanisms of different types of contracts typically used for this situation.

■ MD15

Level 2 - Room 203

Retail Operations

Sponsor: Service Science

Sponsored Session

Chair: Olga Perdikaki, Assistant Professor, Texas A&M University, 320 Wehner Building, College Station, TX, 77843-4217, United States of America, operdikaki@mays.tamu.edu

1 - Drivers and Implications of Direct-store-Delivery in Distribution Channels
Mumin Kurtulus, Assistant Professor, Vanderbilt University, OGSM, 401 21st Ave. South, Nashville, TN, 37203, United States of America, mumin.kurtulus@owen.vanderbilt.edu, Canan Savaskan

Direct-Store-Delivery (DSD) is a channel arrangement in which a retailer allows manufacturer(s) to execute in-store operations such as product replenishment and merchandising at the retail stores. We investigate the economic drivers and implications of DSD for the retailers and manufacturers. We consider a distribution channel where two competing manufacturers sell their products to the consumers via a shelf-space constrained retailer and characterize the conditions under which DSD emerges.

2 - Disclosing Low Stock Levels and Offering Generous Refunds: Compliments or Substitutes?
Tolga Aydinliyim, Assistant Professor, Baruch College, Zicklin School of Business, New York, NY, United States of America, tolga@uoregon.edu

Earlier research has concluded that the Internet retailer can mitigate strategic purchase deferrals by disclosing low stock levels accurately. I investigate how optimal inventory disclosure results change for retailers that implement flexible return policies and offer sizable refunds.

3 - Financing Consumer Purchases - Optimal Credit Strategies for a Monopolistic Retailer
Robert Grueter, EBS University, Konrad-Adenauer-Ring 15, Wiesbaden, 65187, Germany, robert.grueter@ebs.edu, S ebastian Heese

Consumer loans offered directly by retailers are an increasingly important marketing instrument. These loans enable credit-constrained customers to purchase needed goods. On the other hand, longer credit terms imply increased default risk for the retailer. We study a monopolistic retailer's optimal customer financing decisions for different economic and informational settings.

4 - Retail Budget Allocations for Store Labor and Promotions
Olga Perdikaki, Assistant Professor, Texas A&M University, 320 Wehner Building, College Station, TX, 77843-4217, United States of America, operdikaki@mays.tamu.edu, Subodha Kumar, Chelliah Sriskandarajah

The performance of a retailer depends on its ability to attract traffic into its stores and convert the incoming traffic into sales profitably. We establish the relationship between weekly sales performance of a retailer with respect to weekly store traffic, labor force deployment, and intra-day traffic variability. We devise a strategy to allocate limited funds for advertising, early-bird promotions, and labor force for weekly operation in order to maximize store profit.

■ MD16

Level 2 - Room 204

Improved Cancer Diagnosis and Treatment through Operations Research

Sponsor: Health Applications

Sponsored Session

Chair: Kevin Leder, Assistant Professor, University of Minnesota, 111 Church St., Minneapolis, MN, United States of America, Kevin.Leder@isye.umn.edu

1 - Design of Hepatocellular Carcinoma Screening Policies through Reinforcement Learning
Elliot Lee, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48105, United States of America, elliotdl@umich.edu, Mariel Lavieri, Michael Volk

We investigate the problem of allocating a fixed screening capacity amongst a set of patients at risk for hepatocellular carcinoma. The decision maker faces the challenge of incorporating the knowledge of each patient's risk, which is learned over time. The performance of potential strategies from the field of reinforcement learning are compared via simulation. Our models are parameterized and validated using clinical data on 1025 patients followed for over 5 years from the HALT-C trial.

2 - A Stochastic Modeling Approach to Field Cancerization
Marc D. Ryser, Duke University, United States of America, ryser@math.duke.edu, Jasmine Foo, Rick Durrett, Kevin Leder

In many epithelial cancers, the presence of undetectable pre-malignant cell clones increases the risk of recurrence after excision of the primary tumor, and can lead to synchronous or metachronous multifocal cancer lesions. We develop a stochastic model of these field cancerization dynamics and estimate quantities such as waiting times until emergence of cancer, geometry of pre-malignant fields, and recurrence risk. We illustrate our results on the specific example of oral cancer.

3 - Strategic Capacity Planning for New Patient Oncology Appointments

Emma Liu, BC Cancer Agency, 600 West 10th Ave., Vancouver, BC, V5Z4E6, Canada, Emma.Liu@bccancer.bc.ca, Marianne Taylor, Antoine Sauré, Scott Tyldesly, Martin Puterman, Claire Ma

As a consequence of an increasing demand for on-going cancer care, a significant amount of oncologist's time is spent on follow-up appointments with patients. This limits their availability and increases wait times for new patient appointments. This talk describes a British Columbia study of oncologists' patterns of practice intended to provide insights about long-term workload incurred by new patient admissions and how different patterns of practice affect new patient wait times.

■ MD17

Level 2 - Room 205A

E-Commerce

Sponsor: Service Science

Sponsored Session

Chair: Taesu Cheong, Assistant Professor, National University of Singapore, ISE Department, 1 Engineering Drive 2, Singapore, 117576, Singapore, isects@nus.edu.sg

1 - Evaluation of Serivicescape using VR-based Testing Laboratory: A Case Study on a Duty Free Shop

Ryeok-Hwan Kwon, Ph D. Candidate, POSTECH, Quality Systems Lab., Dept. of IME, San 31, Hyoja-Dong, Nam-Gu, Pohang, 790-784, Korea, Republic of, klh1706@postech.ac.kr, Ki-Hun Kim, Kwang-Jae Kim

Serivicescape refers to the physical surroundings that affect service activities of customers and employees. Recently, virtual reality (VR)-based testing laboratories have been introduced. Such a laboratory would be useful in service-scape evaluation in terms of the testing time and costs. This talk presents a case study on the servicescape design evaluation of a duty free shop using VR models.

2 - Online Care vs. Traditional Care: Substitution or Complementary Effects?

Changmi Jung, PhD candidate, Carnegie Mellon University, 4800 Forbes Ave., Room 3009, Pittsburgh, PA, 15213, United States of America, changmi@cmu.edu, Rema Padman, Ateev Mehrotra

Advances in information technology are enabling a transformation from traditional face-to-face encounters between clinicians and patients to online medical consultations, and empowering patients to self-manage their health by accessing their clinical information via portal sites. In this study, we examine empirical evidence of substitution vs. complementary effects, and preliminary results support the substitution effect of eVisit and complement effect of portal usage on office visit frequency.

3 - Enhancing the Value of Business2Business Services

Paul C. van Fenema, Netherlands Defence Academy, Hogeschoollaan 2, Breda, Netherlands, pc.v.fenema@nlda.nl

This study concerns a project in the maritime and offshore sector. Its focus is to reorganize cooperation between regional and major asset-related stakeholders. A method is developed and implemented that pays attention to B2B value cycles, services, and interorganizational and organizational capabilities. Representing organizational, interorganizational and network-level entrepreneurship, Business2Business services are redesigned to achieve strategic objectives of the stakeholders involved.

4 - When Should an Online Retailer Choose Drop-shipping?

Dennis Yu, Associate Professor, Clarkson University, School of Business, Potsdam, NY, 13699, United States of America, dyu@clarkson.edu, Taesu Cheong, Daewon Sun

Conventional in-stock and drop-shipping policies are considered for an online retailer (etailer). By incorporating channel power structures and different decision sequences/variables of the two procurement policies, we study the etailer's optimal procurement policy and supply chain performance. We analyze and compare the two procurement models with respect to the etailer's decision on inventory strategies.

■ MD18

Level 2 - Room 205B

Knowledge Management

Sponsor: Service Science

Sponsored Session

Chair: Rangachari Anand, Research Staff Member, IBM T.J. Watson Research Center, 1101 Kitchawan Rd., Yorktown Heights, NY, 10598, United States of America, ranand@us.ibm.com

1 - Unleashing The Power of Expert Knowledge for IT Services Sales with Graph Search

Mu Qiao, Research Staff Member, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, mqiao@us.ibm.com, Rama Akkiraju, Taiga Nakamura, Debdoot Mukherjee, Daniel Greenia, Shun Jiang

During the sales phase of IT services, the ability to rapidly identify experts allows deal teams to respond efficiently to a client's request for proposal. Interacting with experts can help improve knowledge sharing, which in turn can increase competitive advantage in bidding. We present a novel expert finding approach in complex IT service solution design domain, which extends the value of social graph by providing an efficient way to search through a large amount of complex and connected data.

2 - Professional Service Firms - Developing a Taxonomy for Workforce Planning

Vincent Hargaden, Director, Master of Engineering Management Program, University College Dublin, Engineering & Materials Science Centre, Belfield, Dublin 4, Ireland, vincent.hargaden@ucd.ie, Jennifer Ryan

The area of workforce planning in service systems has gained significant attention recently, with researchers applying different approaches to modeling the various aspects of the human capital supply chain. In this paper, we develop a taxonomy for professional service firms which brings together all the stages of the human capital supply chain. This allows us to identify where and how models can be applied to support the workforce planning process.

3 - The Dialog Manager - A System for Managing Procedural Knowledge

Ying Li, Research Staff Member, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, yingli@us.ibm.com, Qi Cheng Li, Juhnyoung Lee, Kohtaroh Miyamoto, Lijun Mei, Rangachari Anand

The Dialog Manager is a conversational web-based tool that helps organizations manage procedural knowledge in the form of dialogs that serve as interactive guides. It offers a visual knowledge representation and an integrated content management system. The Dialog Manager has been piloted with the Application Management Services practice of IBM Global Business Services. It is being used by teams supporting software applications for large enterprise customers in service engagements.

■ MD19

Level 2 - Room 205C

Call Centers II

Sponsor: Applied Probability

Sponsored Session

Chair: Rouba Ibrahim, University College London, Gower Street, London, United Kingdom, rouba.ibrahim@ucl.ac.uk

1 - Staffing Service Systems with Load Dependent Service Rate

Jing Dong, Columbia University, 500 W 120 Street Room 313, New York, NY, 10027, United States of America, jd2736@columbia.edu, Pnina Feldman, Galit Yom-Tov

Empirical evidence suggests that the service time and the load of the system are correlated in many service systems. Load-related speedup by itself will not worsen performance, while slowdown may decrease customer service level and increase agents' workload dramatically. Hence, we concentrate on the latter, and examine how such dependence affects the operational performance through a modified Erlang-A model. We also propose methods that help stabilize and improve system performance.

2 - Telephone Call Centers: Asymptotic Optimality of Myopic Forecasting-scheduling Scheme

Noah Gans, University of Pennsylvania, Philadelphia, PA, United States of America, gans@wharton.upenn.edu, Yong-Pin Zhou, Haipeng Shen, Han Ye

We determine workforce schedules for call center arrivals that are doubly stochastic. Period-by-period arrival rates follow a hidden AR(1) process, and only arrival counts are observed. We formulate stochastic programs to minimize long-run average staffing costs, subject to a long-run average constraint on abandonment. We show that, in steady state, repeated, myopic solution of the single-period problem is stable, has low cost, and meets the abandonment constraint.

3 - A Method for Estimation of Redial and Reconnect Probabilities in Call Centers

Sihan Ding, Center for Mathematics and Computer Science, Science Park 123, Amsterdam, 1098 XG, Netherlands, S.Ding@cwi.nl, Ger Koole, Rob van der Mei

We study a call center for which the total call volume consists of fresh calls, redials (re-attempts after abandonments) and reconnects (re-attempts after answered calls). We propose a model to estimate the redial and reconnect probabilities and the fresh call volume for call center data without customer identity information. We validate our estimation results via real call center and simulated data.

4 - Models for Service Times in Call Centers

Rouba Ibrahim, University College London, Gower Street, London, United Kingdom, rouba.ibrahim@ucl.ac.uk, Pierre L'Ecuyer, Nazim Regnard, Haipeng Shen

We consider different models for service times in telephone call centers. We evaluate the goodness of fit of our models and their predictive accuracy by describing results from an empirical study analyzing real-life call center data. Our study shows the importance of accounting for agent heterogeneity and correlations between successive service times when predicting future mean service times in the system.

■ MD20

Level 2 - Room 205D

Advances in Stochastic Systems

Sponsor: Applied Probability

Sponsored Session

Chair: Ton Dieker, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, United States of America, ton.dieker@isye.gatech.edu

1 - Stability of MaxWeight-(a,g)

Neil Walton, University of Amsterdam, Science Park 904, Amsterdam, 1098 XH, Netherlands, n.s.walton@uva.nl

The MaxWeight scheduling policies have proved popular, chiefly, because they are throughput optimal and do not require explicit estimation of arrival rates. We prove the same throughput optimality property for a generalization of the MaxWeight policy called the MaxWeight-({\alpha},g) policy. These throughput optimal, myopic scheduling policies allow for scheduling choices similar to those found in bandwidth sharing networks — a further well studied model of Internet congestion.

2 - Queueing with Future Information

Kuang Xu, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, kuangxu@mit.edu, Madhu Sudan, Joel Spencer

Can forecasts significantly improve the performance of queueing systems? We study an admissions control problem: to redirect away incoming jobs up to a fixed rate, in order to minimize the resulting average queue length, Q. We show that Q diverges to infinity in the heavy-traffic regime under any online policy, but can be bounded given (even limited) future forecasts.

3 - Socially Optimal Charging for Electric Vehicles

Elena Yudovina, Postdoc, University of Michigan, Dept. of Statistics, 1085 South University Ave., Ann Arbor, MI, 48109, United States of America, yudovina@umich.edu, George Michailidis

Electric vehicles have started entering different automotive markets. In order to bolster their adoption by consumers, a charging station infrastructure needs to be deployed. We study decentralized policies that assign electric vehicles to a network of charging stations with the goal of minimizing queueing. We establish the asymptotic social optimality of a proposed policy. The results provide insight on how to address questions related to the optimal location deployment of the infrastructure.

4 - Distributionally Robust Inventory Control when Demand is a Martingale

Linwei Xin, PhD Student, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, lwxin@gatech.edu, David A. Goldberg

In multi period inventory models, independence of random demands across different periods is a typical assumption in the literature. In this talk, we consider a distributionally robust inventory model in which the sequence of demands must take the form of a martingale with bounded support. We explicitly compute the optimal policy and draw some interesting conclusions about how much the "independence" and "martingale" assumptions can differ in terms of optimal value and policy.

■ MD21

Level 2 - Room 206

Joint Session HAS\SPPSN: Healthcare Decisions in Resource Constrained Environments

Sponsor: Health Applications & Public Programs, Service and Needs

Sponsored Session

Chair: Mariel Lavieri, Assistant Professor, University of Michigan, 1205 Beal Ave., 2783 IOE, Ann Arbor, MI, 48105, United States of America, lavieri@umich.edu

Co-Chair: Greggory Schell, Ph.D. Candidate, University of Michigan, 1205 Beal Ave., Office 1773, ANN ARBOR, MI, 48109, United States of America, schellg@umich.edu

1 - Comparison of Optimization Models for Insecticide Allocation to Control the Spread of Leishmaniasis

Kaushik Gorahava, Graduate Teaching Assistant, The University of Texas at Arlington, 902 Greek Row Drive, Apt. # 310, Arlington, TX, 76013, United States of America, kgorahava@gmail.com, Jay Rosenberger, Anuj Mubayi

Leishmaniasis is a family of human infectious diseases spread by the bite of sand-flies. Bihar state in India has the highest Leishmaniasis mortality rate in the world. Currently DDT (for controlling Leishmaniasis) is distributed (37.5 grams per individual, under WHO guidelines) according to human population size only, without considering cattle population size. Is this process of insecticide distribution optimal? Our research explores this question by using optimization models.

2 - A Kernel Density Estimation Approach to Optimization of Public Access Defibrillator Locations

Derya Demirtas, University of Toronto, 5 King's College Rd., Toronto, On, M5S 3G8, Canada, demirtas@mie.utoronto.ca, Timothy Chan, Roy Kwon

Sudden cardiac arrest is a major public health issue. Deploying automated external defibrillators (AEDs) in public areas for bystander use reduces the time to defibrillation and improves survival rates. In this talk, we present a kernel density estimation approach to estimate the spatial probability distribution of cardiac arrests. We then use this distribution to generate demand points to optimize and evaluate the models that we developed to guide the deployment of AEDs in public settings.

3 - Patient Scheduling in a Mobile Health Care Setting with Patient No-Shows

Karen Smilowitz, Associate Professor, Northwestern University, Technological Institute M233, 2145 Sheridan Road, Evanston, IL, 60208-3119, United States of America, ksmilowitz@northwestern.edu, Martin Savelsbergh, Samuel Ellis

We present work motivated by an ongoing collaboration with a mobile asthma care provider. Our study focuses on the scheduling challenges caused by patient no-shows. We address this issue through an improved scheduling model that incorporates incentives. We present a comparison with alternate scheduling policies.

4 - Sequential Resource Allocation Decisions for Coronary Heart Disease Patients

Greggory Schell, Ph.D. Candidate, University of Michigan, 1205 Beal Ave., Office 1773, ANN ARBOR, MI, 48109, United States of America, schellg@umich.edu, Mariel Lavieri, Wyndy Wiitala, Jeremy Sussman, Rodney Hayward

We consider the problem of annually allocating limited resources to patients at risk of coronary heart disease, with the objective of minimizing the total number of coronary heart disease events over the planning horizon. Patient-centered decisions are compared to decisions made from a panel perspective. Our models are calibrated using clinical observations collected at U.S. Department of Veterans Affairs hospitals.

■ MD22

Level 2 - Room 207

International Journal of Operations Research (IJOR) and Journal of Industrial and Production Engineering (JIPE)

Cluster: International Activities Committee

Invited Session

Chair: Hsing Luh, NCCU, Dept of Math Science, Nat'l Chengchi Uni, No. 64. Shih Nan Road, Wen-Shan District, Taipei, 116, Taiwan - ROC, slu@nccu.edu.tw

Co-Chair: Kuo-Huang Chang, Assistant Professor, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu, Taiwan - ROC, birdhow@gmail.com

1 - Planning and Coordination of Scattered Hybrid Renewable Energy Systems

Kuo-Hao Chang, National Tsing Hua University, Taiwan - ROC, chang@mx.nthu.edu.tw

We propose a two-stage stochastic programming model to characterize the planning and coordination of scattered hybrid renewable energy systems when the power demand and renewable power are both uncertain. We further propose an efficient method to solve the model. Some realistic size instances are created to validate the viability of the proposed method in real settings.

2 - On Deploying Vehicles for Public Electrical Scooter Sharing Systems

I-Lin Wang, National Cheng Kung University, Tainan, 70101, Taiwan - ROC, ilinwang@mail.ncku.edu.tw

In places of hot or rainy weather that is not biking friendly, electrical scooters may be better vehicles than bikes for a vehicle sharing system. This paper investigates how to deploy electrical scooters in each rental sites, given the estimated origin-destination demands and rates of battery consumption and charging. A mixed integer programming model will be proposed to calculate the optimal fleet deployment, as well as some interesting findings based on our preliminary computational experiments.

3 - The Dynamic Multi-depot Vehicle Routing Problem with Pick-up and Deliveries

Yiyo Kuo, Ming Chi University of Technology, Industrial Engineering and Management, Tainan, 709, Taiwan - ROC, yiyo@mail.mcut.edu.tw

This paper considers the multi-depot vehicle routing problem which deals with two kinds of dynamic request. The first one is repair request which there is an urgent broken product need to be sent form the retail store to a depot for repair. All vehicles can provide the service immediately. The second one is sale request which there is a retail store need a product for sale immediately. The product can be sent form a depot to the store only when the vehicles have returned to depot for up load the product. A heuristic is proposed for solving the problem.

4 - International Journal of Operations Research (IJOR)

Hsing Luh, NCCU, Dept of Math Science, Nat'l Chengchi Uni, No. 64. Shih Nan Road, Wen-Shan District, Taipei, 116, Taiwan - ROC, slu@nccu.edu.tw

In 2003, the call for papers of first issue of the International Journal of Operations Research (IJOR) was brought out. IJOR reports on developments in Operations Research, Information Systems, and Management Sciences, including the latest research results and applications. Its aim is to meet the needs of accelerating technological change and changes in the global economy. Its abstracting/indexing includes Mathematical Reviews, EBSCOhost, Index of Information Systems Journals, CSA's Technology Research Database, CSA's Engineering Research Database, CSA's Industrial & Manufacturing Engineering Database, Zentralblatt MATH, INSPEC. Until October 2013, it has published about 30 issues. The authors come from more than 30 countries presenting research subjects among academia, government and industries.

■ MD23

Level 2 - Room 208A

Topics in Revenue Management and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Dan Zhang, University of Colorado at Boulder, 995 Regent Dr, Boulder, CO, 80305, United States of America, Dan.Zhang@Colorado.EDU

1 - Revenue Management of Network Goods under Demand Uncertainty

Zizhuo Wang, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, zwang@umn.edu, Ming Hu

We study strategic and pricing decisions for firms selling network goods under demand uncertainty. We compare the optimal committed pricing ex ante with and without social interactions, and identify two countervailing effects of allowing social interactions, a pro-interaction risk-seeking effect and an anti-interaction risk saturation effect. We obtain conditions under which curbing or cultivating social interaction is beneficial. We also show that contingent pricing is valuable in our model.

2 - The Impact of Baggage Fees on Airlines' Operations and Demand

Mark Ferguson, Professor, University of South Carolina, 1705 College St., Columbia, SC, 29208, United States of America, mark.ferguson@moore.sc.edu

In 2008, all the major U.S. airlines began charging fees for checked bags with the exception of Southwest. Using data collected from various sources, we study the impact that these fees had on the operational performance of the airlines as well as how it influenced customer demand.

3 - Optimal Pricing of Restaurant Reservations

Jaelynn Oh, University of Pennsylvania, University of Pennsylvania, Philadelphia, PA, United States of America, jaelynn@wharton.upenn.edu, Xuanming Su

We develop a model of restaurant reservations. Walk-in customers wait in a queue, while reservation holders book in advance to avoid queueing but they may not show up. We characterize optimal pricing decisions. Our results highlight several levers that restaurants may use to reduce the number of no-shows.

4 - Reductions of Approximate Linear Programs for Network Revenue Management

Dan Zhang, University of Colorado at Boulder, 995 Regent Dr, Boulder, CO, 80305, United States of America, Dan.Zhang@Colorado.EDU, Thomas Vossen

We consider equivalent reductions of approximate linear programs (ALPs) for network revenue management by exploring the relationship between ALPs and appropriate Dantzig-Wolfe reformulations. Dramatic reduction of ALP problem sizes are shown for (i) separable piecewise linear approximation under independent demand model, and (ii) affine approximation with customer choice behavior.

■ MD24

Level 2 - Room 208B

New Directions in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Omar Besbes, Columbia University, Graduate School of Business, 3022 Broadway, New York, NY, 10027, United States of America, ob2105@columbia.edu

Co-Chair: Gabriel Weintraub, Columbia Business School, Uris Hall 402, New York, NY, United States of America, gyw2105@columbia.edu

1 - The Impact of Competition in Green Technology Adoption

Georgia Perakis, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, United States of America, georgiap@mit.edu, Maxime Cohen, Charles Thraves

We study competition among suppliers for green technologies when government gives subsidies to the consumers. We quantify who is benefiting from competition and when. The results differ depending on demand uncertainty and supplier asymmetry. Competition hurts suppliers and benefits the government but not always the consumers. We also discuss how governments should incentivize new entrants in this market.

2 - Pricing a Bestseller: Sales and Visibility in the Marketplace for Mobile Apps

Bar Ifrach, Postdoctoral Researcher, Stanford University, Huang Engineering Center Room 258, 475 Via Ortega, Stanford, Ca, 94305, United States of America, bifrach@stanford.edu, Ramesh Johari

The market for mobile apps has shown exceptional growth since its launching, exceeding 100 billion app downloads. Taking a combined data-driven and structural approach, the paper focuses on the relationship between pricing decisions and marketplace visibility. We find a strong visibility effect of top ranked charts displayed in the marketplace. Thus motivated, we study a dynamic pricing model and find that this effect supports price cycles, a commonly observed pricing technique in the market.

3 - Optimal Selling Scheme in Social Networks: Hierarchical Signaling, Sequential Selling, and Chain Structure

Ying-Ju Chen, University of California-Berkeley, Department of Industrial Engineering, Berkeley, CA, United States of America, chen@ieor.berkeley.edu, Junjie Zhou

This paper studies the optimal selling scheme when a seller intends to sell a product/service with unknown quality to consumers with heterogeneous knowledge. The model setup features the positive externality, the seller's price discrimination power, and the information transmissions. We identify the consumers' intrinsic signaling incentives and the positive feedback effects, and prove the optimality of chain structure. The revenue-maximizing pricing exhibits the cream skimming property.

4 - Bidding under Budget Constraints in Online Advertising: Shading versus Throttling

Santiago Balseiro, Assistant Professor, Duke University, Durham, NC, United States of America, srb2155@columbia.edu, Omar Besbes, Gabriel Weintraub

Online advertisers typically run campaigns with a fixed budget. A common practice to control expenditures and ensure smooth depletion of budgets is the use of throttling, in which advertisers do not participate in a fraction of the auctions. In this talk, we propose bid shading as an alternative, in which advertisers participate in all auctions but lower bids to account for the option value of future opportunities. We compare the auctioneer's revenue and advertisers' surplus of both approaches.

■ MD25

Level 2 - Room 208C

Electricity Markets

Cluster: Auctions

Invited Session

Chair: Matias Negrete-Pincetic, University of California-Berkeley, Berkeley, CA, United States of America, mnegret2@berkeley.edu

1 - Where is the Missing Money?: The Impact of Ramping Costs in Dynamic Electricity Markets

Matias Negrete-Pincetic, University of California-Berkeley, Berkeley, CA, United States of America, mnegret2@berkeley.edu, Sean Meyn, Luciano De Castro

Can spot markets provide the necessary incentives for flexible generation? We analyze the difficulties of incentivizing flexible generation in a model of a dynamic electricity market with capacity and ramping costs. We show that average prices coincide with average marginal costs of capacity. Hence, ramping costs are not covered by the market. If the market includes a ramping price, then the competitive equilibrium is no longer unique. We give a complete characterization of possible prices.

2 - Inefficiency in Forward Markets with Supply Friction

Wuhan Desmond Cai, California Institute of Technology, 1200 E. California Blvd., MC 305-16, Pasadena, CA, United States of America, wccai@caltech.edu, Adam Wierman

We study an oligopolistic two-settlement market comprising two types of power producers (baseloads and peakers). To model the fact that peakers can ramp up more rapidly than baseloads, we assume that baseloads must choose production levels ahead of peakers. We show that, when the system is capacity-constrained, there may not exist equilibria in which baseloads and peakers play symmetric strategies. We also show connections between our model and the classical Stackelberg game.

3 - On the Design of Electricity Markets

Luciano De Castro, Northwestern University, Evanston, IL, United States of America, l-decastro@kellogg.northwestern.edu, Rakesh Vohra

Conventional wisdom holds that electricity markets should be organized around spot markets, regulated to forestall the exercise of market power. We point out innumerous problems with spot markets and propose a different way of organizing electricity markets, motivated by mechanism design. We show that the optimal mechanism is an auction of option contracts for capacity, but with non-uniform pricing. This is superior to the standard approach in terms of information revelation and efficiency.

■ MD26

Level 2 - Room 208D

Supply Chain Design Under Disruptions

Sponsor: Location Analysis

Sponsored Session

Chair: Qingwei Li, Eastman Chemical Company, 200 Wilcox Dr, Kingsport, United States of America, billdoors0755@gmail.com

1 - Design of Capacitated Supply Chains under the Risk of Disruptions

Pablo Garcia-Herreros, PhD Student, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, pgarciah@andrew.cmu.edu, John M. Wassick, Ignacio E. Grossmann

The supply chain design under the risk of disruptions is formulated as a two-stage stochastic mixed-integer programming problem. We consider the location, allocation of capacity, and inventory management of the distribution centers. We propose a special implementation of Benders decomposition that significantly strengthens the lower bounds. An industrial-scale example is solved showing that this problem can solved effectively, while illustrating the importance of the capacity constraints.

2 - Supply Chain Disruption and Quality

Susan A. Slotnick, Professor, Cleveland State University, BU 542, 2121 Euclid Avenue, Sandusky, OH, 44115, United States of America, s.slotnick@csuohio.edu, Rebecca Clemons

A manufacturer has two suppliers of a critical component. One supplier produces at an acceptable quality level but there is a random possibility of disruption. The second supplier delivers products of lower quality, but without disruption. The manufacturer incurs purchasing, holding and backorder costs, and in each period decides how much to order from each supplier, and how much to spend to raise the quality of the new supplier.

3 - Supply Chain Disruption and Swift Knowledge Transfer

Rebecca Clemons, Doctoral Student, Cleveland State University, 521 West Lakeshore Drive, Port Clinton, OH, 43452, United States of America, clemonsbec@gmail.com, Raymond Henry

Many manufacturers experience situations where disruptions in supply require a new supplier to be brought into production quickly. In this situation it is important to transfer knowledge but time constraints may make typical knowledge transfer processes ineffective. The objective is to examine the critical factors that impact the swift transfer of knowledge within a supply chain.

4 - A Multi-supplier Sourcing Model with Learning and Disruption Risk

Lena Silbermayr, University of Vienna, Brünner Strasse 72, Vienna, 1210, Austria, lena.silbermayr@univie.ac.at, Stefan Minner

A buyer has to deal with the risk of supply disruptions. We study a multi-period order allocation problem of a buyer sourcing from unreliable suppliers which reduce production cost over time through learning. By considering supply disruption risk and learning, we analyze the trade-off between risk reduction via multiple sourcing and learning benefits induced by long-term relationships with a single supplier.

■ MD27

Level 2 - Room 209A

Things We'll Share: Developing Awareness and Sponsorship for Inter-service

Sponsor: Military Applications

Sponsored Session

Chair: Aaron D Burciaga, Senior Scientist, Elder Research, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, burciaga@dataminginglab.com

1 - Scenario Analysis, Policy Evaluation, & Forecasting of Marine Corps Manpower: An Agent-Based Simulation

Andy Garrick, Operations Analyst, Headquarters Marine Corps, Manpower & Reserve Affairs, 3280 Russell Road, Quantico, VA, 22408, United States of America, twelve12finger@gmail.com

Marine Corps manpower is a complex, dynamic system seeking continual alignment of requirements and personnel across skill, grade, availability, unit, time, subject to complex constraints. An agent-based simulation model is presented capable of forecasting, scenario analysis, policy evaluation that is timely, accurate, and integrated along relevant dimensions, considering constraints and policy inputs in a single, integrated model. Methodology relevant for wide range of DoD manpower applications.

2 - Introducing the INFORMS Analytics Maturity Model for Improving Organizational Decision Support

Norm Reitter, Senior Director, Analytics, Syngineering, LLC, 1892 Denver West Court, Denver, CO, 80401, United States of America, norm@reitter.net

Decision makers need assurance that their analytics supports their objectives. INFORMS has developed an analytic maturity model (AMM) designed to help organizations assess themselves, set goals, and justify investments to support improvements. This presentation will provide an overview of the INFORMS AMM and the approach that INFORMS is taking to help members improve organizational conditions, analytical capabilities, and data support to achieve greater business and military outcomes.

3 - Change Detection for Complex Data

George Runger, Professor, Biomedical Informatics, Arizona State, United States of America, runger@asu.edu

The objective is to detect a change in a system based on high-dimensional, disparate data. Challenges Include: changes in only a few attributes (or only in sub-regions), big data is dirty data, no models (nonlinearities). A robust, scalable strategy will be presented that can be applied to different data representations such as traditional time-ordered data, events as point-processes in a high-dimensional space (of numerical and categorical attributes), or network transactions.

■ MD28

Level 2 - Room 209B

Multiple Perspectives

Cluster: Data Envelopment Analysis

Invited Session

Chair: Xiaopeng Yang, University of Toronto, 200 College Street, Toronto, ON, Canada, xiaopeng.yang@utoronto.ca

1 - Determinants of Airline's Efficiency: A Comparative Study over Three Categories in a Panel Data

Maria Cristina Gramani, Insper Institute of Education and Research, Rua Quata, 300, Vila Olimpia, Sao Paulo, SP, 04546-042, Brazil, mariacng@insper.edu.br

This study seeks to investigate the performance of three airline's categories: regional, low cost and full service. Empirical results are based on a panel data for 13 Brazilian airlines and 3 international airlines within the period from 2005 to 2010. The contribution of this work consists of -put side by side the results of operational and financial performances for airlines in a panel data; -verify the potential improvements for each segment; and -analyze the benchmarking best practices.

2 - Benchmarking of Municipality Service in Denmark

Peter Bogetoft, Copenhagen Business School, Copenhagen, Denmark, pb.eco@cbs.dk

We use DEA with weight restrictions to construct a benefit-of-the-doubt measure of the overall service levels in Danish municipalities. We also introduce costs to get an evaluation of their efficiency. Lastly, we show how Interactive Benchmarking IB support learning and strategic planning in the individual municipalities and we discuss how the municipalities have reacted to the results and the tool.

3 - Nonlinear Problems in Efficiency Analysis under Multiple Perspectives

Xiaopeng Yang, University of Toronto, 200 College Street, Toronto, ON, Canada, xiaopeng.yang@utoronto.ca, Hiroshi Morita, Joseph Paradi

Multiple perspectives have different input/output classifications, which always result in nonlinear problems in either efficiency evaluation or improvement processes. To address such problems, we propose a new DEA model by incorporating SQP method into actual calculation. An application in banking sector is used to validate our model.

■ MD29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - SAS - Building and Solving Optimization Models with SAS

Ed Hughes, SAS/OR Product Manager, SAS, SAS Campus Dr.,, Cary, NC, 27513, United States of America, ed.hughes@sas.com, Rob Pratt

OPTMODEL from SAS provides a modeling environment featuring a powerful and intuitive algebraic optimization modeling language and unified support for building and solving LP, MILP, QP, NLP, and network models. We'll demonstrate OPTMODEL for basic and advanced problems, highlighting its newer capabilities and its support for both standard and customized solution approaches.

2 - Responsive Learning Technologies, Inc. - Online Games to Teach Operations and Supply Chain Management

Sam Wood, Responsive Learning Technologies, Inc., 4546 El Camino Real, Ste. 239, Los Altos, CA, United States of America, wood@responsive.net

Learn about online competitive exercises that are used in operations management courses and supply chain management courses to teach topics like capacity management, lead time management, inventory control, supply chain design and logistics. These games are typically used as graded assignments.

■ MD30

Level 2 - Room 210B

Optimization Methodologies

Contributed Session

Chair: Joris Kinable, PhD Student, KU Leuven, Gebroeders de Smetstraat 1, Gent, 9000, Belgium, joris.kinable@kuleuven.be

1 - The Lagrange Duality of Multi-objective Programming under the Conditions of E-convex

Xiaogan Jiang, Southeast University, Sipailou 2, Nanjing, China, jiangxiaogan@163.com

This paper mainly studies some properties of the e-convex multi-objective programming.First we define the e-convex multi-objective programming,then we discuss the lagrange duality of e-convex multi-objective programming, and prove its weak duality,direct duality and converse duality.

2 - A Genetic-algorithm Based Heuristic for a New Model of the Dynamic Berth Allocation Problem

Ahmed Simrin, Research Assistant, Masdar Institute, Khalifa City A, St. 20, Abu Dhabi, United Arab Emirates, asimrin@masdar.ac.ae, Ali Diabat

International shipping is a multi-billion dollar business. Large benefits could be made by improving and optimizing container terminal operations. In this paper, we propose a new formulation for one of the most important container terminal operations - the dynamic berth allocation problem (DBAP). We present a mixed integer program (MIP) of the problem, and use a genetic algorithm (GA) heuristic to solve it.

3 - A Genetic Algorithm for the Integrated Quay Crane Assignment and Scheduling Problem

Yi-Min Fu, Masdar Institute, Masdar Institute, PO BOX54224, Abu Dhabi, United Arab Emirates, yfu@masdar.ac.ae, Ali Diabat

This paper develops a new approach for integrated quay crane assignment and scheduling problem (QCASP), considering safety margins between quay cranes (QCs) and ordering conditions. The priority of ships is also taken into consideration. The integrated problem is hard to be solved using exact method due to its complexity. Therefore, this paper proposes a genetic algorithm (GA) for this integrated model. Furthermore, computational results are provided to verify the performance of the proposed GA.

4 - Multi-objective Geometric Programming Problem with Epsilon Constraint Method

Akshay Kumar Ojha, Associate Professor in Mathematics, Indian Institute of Technology, Bhubaneswar, Samantapuri, Bhubaneswar, Bhubaneswar, Od, 751013, India, akojha57

In multi-objective Geometric Programming Problem there are more than one objective functions. There is no single optimal solution which simultaneously optimizes all the objective functions. Under these conditions the decision makers always search for the most "preferred" solution, in contrast to the optimal solution. In this paper epsilon constraint method has been applied to find the non-inferior solution and the result so obtained is compared with that of Fuzzy programming. .

5 - Crux 25 - Circle Packing

Joris Kinable, PhD Student, KU Leuven, Gebroeders de Smetstraat 1, Gent, 9000, Belgium, joris.kinable@kuleuven.be, Tony Wauters

Crux 25 is a small tabletop puzzle in which one has to place 25 circles of different sizes inside a larger circle. Despite the small number of pieces, it is surprisingly difficult to solve by hand. In this work we study the more general problem of positioning a set of circles inside a container. Of special interest is the minimization problem obtained when searching for the smallest container capable of fitting a predefined set of circles. Both exact and heuristic approaches are considered.

■ MD31

Level 2 - Room 211A

Spreadsheet Applications and Examples

Sponsor: Spreadsheet Productivity Research Interest Group

Sponsored Session

Chair: Thomas Groleau, Professor, Carthage College, 2001 Alford Park Drive, Kenosha, WI, 53140, United States of America, tgroleau@carthage.edu

1 - Spreadsheet Templates for Teaching Business Statistics

Thomas Groleau, Professor, Carthage College, 2001 Alford Park Drive, Kenosha, WI, 53140, United States of America, tgroleau@carthage.edu

Demonstration of Excel spreadsheet templates provided to students in an introductory business and economics statistics course. Rather than use a spreadsheet add-in, non-macro templates are used. Students create their own templates for some problems, use teacher provided templates for others. Also, an interactive template us used to replace one chapter's set of PowerPoint slides.

2 - The Spreadsheet Guru Contest

Rick Carter, Equation Consulting, 2650 S. Decker Lake Blvd, Salt Lake City, UT, United States of America, rcarter@equationconsulting.com

SPRIG (the Spreadsheet Productivity Research Interest Group) has sponsored a Spreadsheet Guru competition at each of the last two Spring INFORMS Analytics meetings. The contest, focusing on spreadsheet technique and speed, originated as an internal contest for Equation Consulting. Sample problems will be demonstrated and the future of the contest discussed.

3 - Spreadsheet Design to Minimize Risk of Errors

Larry LeBlanc, Vanderbilt University, Owen Graduate School of Management, 401 21st Ave. S, Nashville, TN 37203, United States of America, larry.leblanc@owen.vanderbilt.edu, Michael R. Bartolacci

Spreadsheet risk is the chance of adverse operational or financial consequences due to erroneous creation or use of spreadsheets. Such errors can result in poor supply chain or manufacturing or investment decisions, including failure to identify good investments. As spreadsheets have proliferated, this risk has become serious. We describe alternative ways to design spreadsheets to minimize spreadsheet risk. Examples are given of error-prone designs and superior approaches for the same result.

■ MD32

Level 2 - Room 211B

TMS Distinguished Speaker

Sponsor: Technology Management

Sponsored Session

Chair: Juliana Hsuan, Professor, Copenhagen Business School, Department of Operations Management, Solbjer Plads 3, Frederiksberg, DK-2000, Denmark, jh.om@cbs.dk

1 - Innovation and Technology Management in the Technology Era

Dundar Kocaoglu, Professor, Portland State University, Department of Engineering and Technology, Portland, OR, 97207, United States of America, kocaoglu@etm.pdx.edu

Every era in human history has had its characteristics shaped by the dominant forces representing that era. The technology era that the world has now entered is following the same pattern. It is clear that technology is the dominant force in the world of the 21st century where rapid technological changes are leading to rapid societal changes. The opportunities and challenges of managing and leading the technology era are discussed in this presentation.

■ MD33

Level 2 - Room 211C

OR Applications in Homeland Security

Cluster: Homeland Security/Defense

Invited Session

Chair: Sinan Tas, Assistant Professor, Pennsylvania State University, 1800 Broadcasting Road, Reading, PA, 19610, United States of America, sut12@psu.edu

1 - Trading off between Resource Allocation to Prepare for and Recover from Disruptions

Cameron MacKenzie, Assistant Professor, Naval Postgraduate School, Monterey, CA, United States of America, camacken@nps.edu

We develop a model to help a decision maker allocate resources to prepare for a disruption and to help individual industries recover if the disruption occurs. The decision maker chooses these allocation amounts with the objective of minimizing the expected production losses from the disruption. The Deepwater Horizon oil spill serves as a real-world case study for this decision model. The model can be applied to different homeland security situations.

2 - Using Heuristics to Address Various Levels of Cascading and Restoration Knowledge of Adversaries

Sinan Tas, Assistant Professor, Pennsylvania State University, 1800 Broadcasting Road, Reading, PA, 19610, United States of America, sut12@psu.edu, Vicki Bier

Our user-friendly, heuristic-based, and game-theoretic flow model enables the defender to address various concerns to a complex system, such as cascading failures or system recovery. Furthermore, it addresses less optimal but quite realistic attack scenarios, such as attacking certain component types with varying level of cascading knowledge and restoration process. In this talk, we will provide several examples for the latter.

■ MD34

Level 2 - Room 211D

In Honor of Saul Gass II

Cluster: In Memoriam: Saul Gass's Influence in OR

Invited Session

Chair: Arjang Assad, Dean and Professor, University at Buffalo, State University of New York, 160 Jacobs Managemt Center, Buffalo, NY, 14260-4000, United States of America, aassad@buffalo.edu

Co-Chair: Michael Fu, Professor, University of Maryland, Smith School of Business, Van Munching Hall, College Park, MD, United States of America, mfu@umd.edu

1 - British OR in the "Peace" (1945-1970)

Graham Rand, Lancaster University, Lancaster, United Kingdom, g.rand@lancaster.ac.uk

This presentation arises from two contributions to the Gass and Fu encyclopedia. OR in WWII is well documented. Less well known is what happened next. In the UK, OR was taken up in the nationalized industries and in private companies, but did not make much impact in the public sector. This diffusion of OR was helped by the creation of the OR Club which became the OR Society, of which Saul Gass was a member. Key aspects of the development of OR in this period will be highlighted.

2 - Saul Gass: A Walking, Talking Encyclopedia of O.R.

Peter Horner, Editor, Lionheart Publishing, 506 Roswell St., Suite 220, Marietta, GA, 30060, United States of America, horner@lionhrtpub.com

While Saul Gass played an instrumental role in the lives of countless O.R. students through his teaching, tutelage and textbooks, he also served the greater O.R. community in his unofficial yet widely recognized role as an O.R. pioneer, statesman, ambassador and historian. This talk focuses on the latter, particularly his encyclopedic knowledge of all things O.R. and his many contributions over the past two decades to OR/MS Today, as observed and appreciated by the editor.

3 - Saul Gass as Writer, Expositor, and Co-author

Arjang Assad, Dean and Professor, University at Buffalo, State University of New York, 160 Jacobs Managemt Center, Buffalo, NY, 14260-4000, United States of America, aassad@buffalo.edu

Saul Gass was a prolific writer and an award-wining expositor of OR. This talk will review Saul's various contributions to the history, traditions, and teaching of OR. I will also describe my experience of working with Saul on the history of OR resulting in two books: "Annotated Timeline of OR" (2004) and "Profiles in Operations Research: Pioneers and Innovations" (2011).

4 - Saul's Encyclopedia of OR/MS

Michael Fu, Professor, University of Maryland, Smith School of Business, Van Munching Hall, College Park, MD, United States of America, mfu@umd.edu

Saul Gass' last project was the 3rd edition of the Encyclopedia of Operations Research and Management Science, published by Springer this year posthumously. The 1st and 2nd editions were published in 1996 and 2001, respectively, by Kluwer Academic Publishers, with Carl Harris as co-editor. This talk will be about my dear friend and colleague Saul and the Encyclopedia, for which I was privileged to be able to serve as co-editor.

■ MD35

Level 2 - Room 212A

Social Media and Electronic Business

Sponsor: E-Business

Sponsored Session

Chair: Jie Zhang, University of Texas at Arlington, 701 S West St. #19437, Arlington, TX, 76019, United States of America, jiezhang@uta.edu

1 - Virtual Team Performance in Crowdsourcing Contests

Indika Dissanayake, University of Texas at Arlington, 701 S. West Street, Arlington, TX, 76019, United States of America, indika.dissanayake@mavs.uta.edu, Jie Zhang, Bin Gu

During last few years, we witnessed many organizations find solutions to their vital business problems with the aid of online contests. Self-organized virtual teams participate and collaborate online in these contests and compete among themselves for monitory reward. Motivated by this phenomenon, this research investigates what impacts the performances of virtual teams in the context of crowdsourcing contests.

2 - Technology, Interoperability, and Provision of Public Safety Networks

Hong Guo, Assistant Professor, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo19@gmail.com, Yipeng Liu, Barrie Nault

This paper analyzes the key tradeoffs in provisioning public safety networks. Under decentralized provision, individual districts' technology choices jointly determine the interoperability. Under centralized provision, one uniform technology is chosen to maximize the interoperability while accommodating local needs. In contrast to common public opinions, we find that a decentralized system may provide better quality of services when technology preferences are highly diversified across districts.

3 - Real-time Diffusion of Information on Twitter and the Financial Markets

Ali Tafti, University of Illinois, 350 Wohlers Hall, 1206 S. Sixth Street, Champaign, IL, 61820, United States of America, atafti@illinois.edu, Wolfgang Jank, Ryan Zotti

We study the real-time relationship between chatter on Twitter and the trading volume and stock price of Nasdaq 100 firms. This study has two primary objectives as a research contribution. First, the study represents a microscope upon the diffusion of information in social networks that becomes observable at a resolution of minutes. Second, the approach allows a better understanding of how market value is influenced by events in real-time.

4 - Social Media Blog Sentiments and Brand Performances: Competitive and Asymmetric Effects

Jie Zhang, University of Texas at Arlington, 701 S West St. #19437, Arlington, TX, 76019, United States of America, jiezhang@uta.edu, Xueming Luo, Bin Gu, Chiwei Phang

In this study, we investigate the competitive effects of social media on consumer sentiments and brand performances of firms operating in the same industry. We assembled a novel, comprehensive dataset that combined the extent of social media presence of competing brands in the personal computer industry; and individual consumers' evaluations of the brands collected at a daily level. Our analyses of this unique dataset unveil three key insights.

■ MD36

Level 2 - Room 212B

Transportation and Routing in Public Policy

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Ronald McGarvey, Assistant Professor, University of Missouri, Lafferre Hall, Columbia, MO, 65211, United States of America, mcgarveyr@missouri.edu

1 - Estimating the Potential Benefits of Banning Drivers' use of Hand-held Wireless Devices

Douglas King, Visiting Lecturer, University of Illinois at Urbana-Champaign, Department of Industrial and Enterprise Systems Engineering, 117 Transportation Bldg., 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, dmking@illinois.edu, Matthew Robbins, Sheldon Jacobson, Kevin Ryan

Hand-held wireless devices (e.g., cell phones) are considered a distraction to drivers, leading many states to ban drivers from using them. This talk examines how accident rates at the county level have evolved over time in New York and Pennsylvania to assess the potential impact of such legislation. These results suggest that the impact of these bans is associated with the driver density in a county, defined as the number of licensed drivers per centerline mile of roadway.

2 - Optimization-based Cost-benefit Analysis: Government vs. Commercial Provision of Transportation

Ronald McGarvey, Assistant Professor, University of Missouri, Lafferre Hall, Columbia, MO, 65211, United States of America, mcgarveyr@missouri.edu, Ricardo Sanchez, Tom Light, Brent Thomas

Intratheater airlift delivers time-sensitive supplies, such as blood products for transfusions, to deployed forces. Traditionally, military aircraft have provided this airlift. However, commercial carriers were providing a significant amount of this airlift circa 2009. But was this more cost-effective than using U.S. Air Force aircraft? To explore this question, we utilized econometric and optimization models to identify the most cost-effective combination of commercial and government airlift.

3 - Social Media Usage in Disaster Relief Routing

Emre Kirac, PhD Student, University of Arkansas, Department of Industrial Engineering, Fayetteville, AR, 72701, United States of America, ekirac@uark.edu, Ashlea Bennett Milburn

The information available for disaster planning includes that from sources such as on the ground assessment teams. Data may also be obtained through social media, enabling a more needs to be identified in less time. However, this information is not verified and may be inaccurate. We construct models to assess tradeoffs associated with considering this new information in planning efforts. Alternative decision approaches are presented and compared across wide variety of request scenarios.

■ MD37

Level 2 - Room 213A

Optimization and Mechanism Design

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Nicholas G. Hall, Ohio State University, 2100 Neil Avenue, 658 Fisher Hall, Columbus, OH, 43210-1144, United States of America, hall_33@fisher.osu.edu

1 - Managing Underperformance Risk in Project Portfolio Selection

Jin Qi, National University of Singapore, Singapore, qijin@nus.edu.sg, Melvyn Sim, Nicholas G. Hall, Zhuoyu Long

We consider a project selection problem where each project has an uncertain return with partially characterized probability distribution. The decision maker selects a feasible subset of projects so that the risk of the portfolio return not meeting a specified target is minimized. Our work extends the riskiness index of Aumann and Serrano (2008) by incorporating the target and also distributional ambiguity. We minimize the underperformance risk and capture correlation and interaction effects.

2 - The Design of Incentive Compatible Mechanisms in Project Management

Nicholas G. Hall, Ohio State University, 2100 Neil Avenue, 658 Fisher Hall, Columbus, OH, 43210-1144, United States of America, hall_33@fisher.osu.edu, Bo Chen, Xiaotie Deng

Parkinson's Law often results in poor project performance. We describe an incentive compatible mechanism to resolve Parkinson's Law for projects planned under the critical path method. We describe an incentive compatible mechanism to resolve Parkinson's Law for projects planned under critical chain project management. We develop an incentive compatible mechanism for repeated projects. A computational study shows that our scheme provides significant improvement in typical project performance.

3 - Minimizing Activity Costs in Networks with Resource Options

George Vairaktarakis, Professor, Case Western Reserve University, CWRU, Cleveland, OH, United States of America, gxv5@case.edu

We consider the problem of minimizing the weighted flowtime of a set of activities processed by unrelated processors subject to network constraints. This problem subsumes important objectives like project duration, activity-in-progress costs, and manufacturing settings like flow shops and job shops. We develop efficient tight lower bounds, near-optimal heuristics, and perform extensive computational experiments to assess the performance of our algorithms on randomly generated networks.

4 - Battery Scheduling under Various Objectives

Johann Hurink, University of Twente, PO Box 217, Enschede, Netherlands, j.l.hurink@utwente.nl, Thijs van der Klauw

We consider scheduling an energy storage to match a given energy production profile to a predefined target profile. This problem has applications in smart grids where storage can be used to control the output of e.g. wind or PV. We treat the objectives to minimize the number of charging cycles or the total energy flow through the battery and show the boundary between polynomial solvable and NP-hard problems. We also investigate the case where multiple batteries are used in parallel.

■ MD38

Level 2 - Room 213B

Evolutionary Multi-Objective Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Kalyanmoy Deb, Electrical and Computer Engineering, Michigan State University, East Lansing, MI, 48824, United States of America, kdeb@egr.msu.edu

1 - Innovization: Discovery of Innovative Knowledge through Multi-criterion Optimization

Kalyanmoy Deb, Electrical and Computer Engineering, Michigan State University, East Lansing, MI, 48824, United States of America, kdeb@egr.msu.edu

A consideration of multiple conflicting objectives allows us to find multiple trade-off solutions. Since these solutions are near-optimal, an analysis of them should reveal important insights about common principles shared by these solutions. We show the importance of "innovization" by demonstrating on a number of practical problem solving tasks.

2 - An Improved NSGA-II for Dynamic Design of Multi-objective Reverse Logistics Network

Shuang Li, School of Management, Xi'an Jiaotong University, PO Box 1850, No.28, Xianning West Road, Xi'an, 710049, China, lishuang615@stu.xjtu.edu.cn, Nengmin Wang

This paper addresses the problem of multi-period, multi-objective reverse logistics network design for post-sale repair service. We propose a multi-objective linear mix-integer programming model with the objectives of minimizing the total reverse logistics cost and maximizing consumer satisfaction. To solve this multi-objective problem, an improved Non-dominated Sorting Genetic Algorithm II (NSGA-II) is developed. Its advantage over basic NSGA-II is validated by numerical examples.

3 - A Multi-objective Approach to Improve Civil Infrastructure System Resilience Against Natural Hazards

Brian Piper, North Carolina State University, 2500 Stinson Drive, Raleigh, NC, 27695, United States of America, piper.brian@gmail.com, Ranji Ranjithan

We present a framework to quantify multiple aspects of the resilience of a civil infrastructure system subjected to natural hazards. Engineering improvements are selected to limit the consequences of a range of potential hazard scenarios. A novel multiobjective evolutionary algorithm is used to search for nondominated and nearly-nondominated solutions with decision space diversity. The algorithm's effectiveness is shown on realistic data from a coastal community.

4 - Seeking Useful Alternatives in Multi-objective Search using Evolutionary Algorithms

Hana Chmielewski, Graduate student, North Carolina State University, Campus Box 7908, NCSU Campus, Raleigh, NC, 27695-7908, United States of America, hanatchmielewski@gmail.com, Ranji Ranjithan

The benefit of providing diverse solution sets in an optimization problem depends on how alternatives are identified in the decisionmaking process. Solution space diversity may be calculated amongst all solutions, or just certain solutions or variables. How alternative solutions compare with respect to modeled and unmodeled objective performance is investigated in a water network design problem. Two approaches, an evolutionary algorithm and mixed integer linear programming are compared.

■ MD39

Auditorium 3

Joint Session TSL/RAS: Rail Systems Management and Maintenance

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics & Railway Applications

Sponsored Session

Chair: Alejandro Toriello, Assistant Professor, University of Southern California, 3715 McClintock Ave., GER 240, Los Angeles, CA, 90089, United States of America, toriello@usc.edu

1 - Dynamic Headway in Positive Train Control

Lunce Fu, University of Southern California, Los Angeles, CA, United States of America, luncefu@usc.edu, Maged Dessouky

We consider dynamic headway control problem under no-deadlock and no-collision constraints. Different speed limits are applied to different railway segments and junctions according to local locations. Moreover, trains' dynamics is taken into consideration. A train movement rule is proposed to reduce delays and guarantee security. And we evaluate how dynamic headway will influence the efficiency of the system through simulation of passenger and freight trains in Los Angeles County.

2 - Mathematical Model for the Evaluation and Planning of Railroad Track Maintenance

Alexander Lovett, University of Illinois at Urbana-Champaign, 205 N Mathews Ave., B118 NCEL, MC-250, Urbana, IL, 61801, United States of America, alovett2@illinois.edu, Christopher Barkan, Conrad Ruppert

In order to reduce maintenance costs a mathematical model was developed to prioritize maintenance activities based on their cost and potential for risk reduction. The model has three components: degradation modeling, project evaluation, and optimization based on relative costs and benefits. The component formulation has the result of allowing for a conceptual development with simplified information that can be updated as new information becomes available.

3 - Optimal Investments, Divestments and Maintenance in Railroad Infrastructure under Uncertainty

Arnt-Gunnar Lium, Research scientist, SINTEF, S.P. Andersens vei 5, Trondheim, 7465, Norway, arnt-gunnar.lium@sintef.no, Truls Flatberg, Marte Fodstad, Michal Kaut

We present a model that enables the traditional cost benefit analysis to take into account portfolio effects associated with strategic investments in railroad infrastructure, while at the same addressing exogenous uncertainty. The model is to be applied by the Norwegian infrastructure manager (Jernbaneverket) in their investment decisions.

■ MD40

Auditorium 2

Panel Discussion: OR for Science and Engineering Grand Challenges

Cluster: OR as a Catalyst for Engineering Grand Challenges

Invited Session

Chair: Andrew Boyd,

1 - Panel: OR for Science and Engineering Grand Challenges

Moderator: Barry Nelson, Chair Professor, Northwestern University, 2145 Sheridan Road, Room C216, Evanston, IL, United States of America, nelsonb@northwestern.edu, Panelists: Dorit Hochbaum, David Morton, Warren Powell, David Yao, Andrew Boyd, Christine Shoemaker

The report on Engineering Grand Challenges commissioned by the National Academy of Engineering identified several important research areas in which breakthroughs would transform our world in one or more ways, including sustainability, security, human health, and our joy of living in general. This panel will discuss how OR might play the role of a catalyst for advances in the above research areas.

■ MD41

Level 1 -101A

Socially-Responsible Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Mili Mehrotra, Assistant Professor, The University of Minnesota, 321 19th Ave. South, #321, Minneapolis, MN, 55406, United States of America, milim@umn.edu

1 - Milk Supply Chain: Improving Quality under Competing Intermediaries

Liying Mu, PhD Student, University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, 75080, United States of America, muliying@utdallas.edu, Milind Dawande, Vijay Mookerjee

Quality issues in milk - arising primarily from deliberate adulteration by producers - have been widely reported. High testing cost, free riding among producers, and competition between milk stations, are identified as the main causes for low milk quality. We examine confessor rewards, quality rewards, penalties, pre-mixed individual testing, and post-mixed individual testing. We propose a mechanism to incentivize high-quality milk from producers under minimal testing by stations.

2 - Resources for Results: Funding Social Development Projects through Market Mechanisms

Sripad Devalkar, Indian School of Business, Ac3 L1 Room 3114, Gachibowli, Hyderabad, 500032, India, sripad_devalkar@isb.edu, Milind Sohoni

Traditionally, a NGO raises funds from donors before implementing the project. This exposes the donors to a high level of uncertainty, resulting in challenges for the NGO to raise funds. In contrast, some NGOs have moved towards outcome based funding where a NGO implements the project in phases, using its own corpus to implement the initial phases, and securitizes the results from these phases to raise future funds. We examine the challenges of using a results based funding model for an NGO.

3 - How Can Operations Management Methods Reduce System-wide Food Waste and its Environmental Impact?

Alexandra Heeney, PhD Student, Stanford University, 566 Arguello Way, Apt. 117, Stanford, CA, 94305, United States of America, aheeney@stanford.edu, Warren H. Hausman, Dariush Rafinejad

Worldwide, 30-40% of food is wasted at all levels of the supply chain - approximately 1.3 billion tonnes - and every kilo or tonne of that food generates at least 4.5 times that amount of carbon dioxide emissions which could have been avoided. By taking a supply chain perspective, this talk explores how to model the food distribution, taking into account environmental externalities, and how improving system operations or influencing strategic consumer behavior could help mitigate food waste.

■ MD42

Level 1 -101B

Operational Decisions under Uncertainty

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Tim Huh, Associate Professor, University of British Columbia, Sauder School of Business, Vancouver, BC, V6T 1Z2, Canada, tim.huh@sauder.ubc.ca

Co-Chair: Mahesh Nagarajan, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6tT 1Z2, Canada, mahesh.nagarajan@sauder.ubc.ca

1 - Integrality in Stochastic Inventory Models

Wei Chen, University of Texas-Dallas, Richardson, TX, United States of America, wxc103020@utdallas.edu, Milind Dawande, Ganesh Janakiraman

We study several finite-horizon, discrete-time, dynamic stochastic inventory control models with integer demands and starting inventory levels. Equivalent linear programs are formulated for the corresponding stochastic dynamic programs, and integrality results are derived based on the total unimodularity of the constraint matrices. A second approach based on multi-dimensional piecewise linearity of the cost-to-go functions to establish integrality is also presented.

2 - Using Expert Assessments to Estimate Operational Uncertainty
Saurabh Bansal, Pennsylvania State University, 405 Business Building, University Park, PA, United States of America, sub32@psu.edu, Genaro Gutierrez

In industries with a rapid innovation rate, historical data seldom exists to provide credible probability distributions. We develop a systematic approach to use subjective estimates of fractiles provided by experts to obtain estimates of the mean and variance of probability distributions. We illustrate the application of the theory developed using an ongoing implementation at a seed corn producer for the estimation of yield uncertainty.

3 - United We Stand, Divided We Fall: Strategic Supplier Alliances under Default Risk
Xiao Huang, Assistant Professor, John Molson School of Business, Concordia University, 1455 de Maisonneuve Blvd W., Montreal, QC, H3G 1M8, Canada, xiaoh@jmsb.concordia.ca, Tamer Boyaci, Mehmet Gumus, Saibal Ray, Dan Zhang

We study alliance formation among a set of complementary/substitutable suppliers selling to an assembler/buyer. The suppliers balance the strategic benefit of joining large alliances (lower chance to default) vs operational benefit to stay with small alliances (higher profit allocation). Coalition-proof stable alliance structures are characterized. We also find that the stakeholders' investment strategy in upstream risk construction can have contrasting impact on the supplier community.

4 - Current Challenges in Kidney Exchange
Itai Ashlagi, Assistant Professor, Massachusetts Institute of Technology, E-62, Cambridge, MA, United States of America, iashlagi@mit.edu

Kidney exchange has grown into an enterprise involving many hospitals and overlapping exchange networks, and in the process the set of strategic players has changed, and so has the patient pool. I'll discuss recent market design developments and further challenges.

■ MD43

Level 1 -101C

Operations Economics

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Gabriel Weintraub, Columbia Business School, Uris Hall 402, New York, NY, United States of America, gyw2105@columbia.edu

Co-Chair: Gad Allon, Professor, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu

1 - A Model of Rational Retrials in Queues
Shiliang Cui, Doctoral Student, The Wharton School, University of Pennsylvania, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, scui@wharton.upenn.edu, Senthil Veeraraghavan, Xuanming Su

We study a queueing setting in which a rational consumer can choose to "retry" a service later, at a cost, on observing the congestion at the system (e.g. lines at the DMV). Thus he may join, balk or retry. Such consumer retrials could be costly, and have both positive and negative externalities. We show that under specific conditions, allowing consumers to retry improves throughput at the service, and may also improve consumer and social welfare.

2 - Framework Agreements in Procurement: An Auction Model and Design Recommendations
Gabriel Weintraub, Columbia Business School, Uris Hall 402, New York, NY, United States of America, gyw2105@columbia.edu, Yonatan Gur, Lijian Lu

Framework agreements (FAs) are procurement mechanisms commonly used by buying agencies to satisfy demand that arises randomly over a certain time horizon. In this work, we introduce and analyze one of the first FA models in the literature. We provide concrete design recommendations based on our results. These recommendations are being used by the Chilean government to improve their FAs that amount to US$1.9 billion worth of contracts every year.

3 - Managing Customer Expectations and Priorities in Service Systems
Qiuping Yu, Northwestern University, Evanston, IL, United States of America, QiupingYu2009@u.northwestern.edu, Gad Allon, Achal Bassamboo

We study in a service environment, how to manage customers' expectations and to prioritize customers appropriately to maximize the firm's profits. Specifically, we focus on a setting where the firm uses only delay announcements and study the opportunities and limitations of this mechanism. We are particularly interested in when and how the customers can be influenced by delay announcements.

4 - The Operational Advantage of Threshold Discounting Offers in the Presence of Strategic Customers
Simone Marinesi, INSEAD, 257 Rue Saint Martin, Paris, 75003, France, Simone.MARINESI@insead.edu, Karan Girotra, Serguei Netessine

We study the operational advantage of Threshold Discounting Offersói.e. the practice to offer a discounted service conditional on enough customers subscribing to the offeróas employed by Groupon and its competitors, in the presence of strategic customers. We find that Threshold Discounting increases operational performance and profit compared to more traditional approaches, even in the absence of economies of scale. We also find that strategic customers are beneficial to the firm.

■ MD44

Level 1 -101D

Topics in Supply Chain Responsibility

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Sang Kim, Associate Professor, Yale University, New Haven, CT, 06520, United States of America, sang.kim@yale.edu

1 - Managing Suppliers: Joint Audit and Shared Supplier Information
Xin Fang, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, xfang@andrew.cmu.edu, Soo-Haeng Cho

Product safety incidents in recent years have compelled many manufacturers to rethink approaches to manage product quality of their suppliers. In this paper, we consider two approaches: joint audit and sharing quality information of suppliers. Based on a model with both cooperative and competitive interactions between firms, we investigate the impacts of the two approaches on product quality and the incentives of manufacturers to conduct joint audit or share their private supplier information.

2 - Dynamics of a Responsible Business Relationship
Pavel Izhutov, Stanford University, 736 Escondido Rd., Apt. 203, Stanford, CA, 94305, United States of America, izhutov@stanford.edu, Hau L. Lee

We analyze the investment decisions on responsible operations by suppliers under three sourcing modes: (1) spot market, (2) long-term relationships, and (3) long-term contracts. The results show that the sourcing mode can affect the supplier's investment decisions in non-trivial ways.

3 - An Analysis of Injectable Drug Shortages: Manufacturer Incentives and Social Impact
Sang Kim, Associate Professor, Yale University, New Haven, CT, 06520, United States of America, sang.kim@yale.edu

In recent years severe shortages of sterile injectable drugs have persisted in the U.S., creating life-threatening situations for many patients. There are many contributing factors, including Medicare reimbursement policy, high concentration of generics drug manufacturers, and frequent supply disruptions. We set up a stylized model of manufacturers' capacity decisions under supply disruptions that capture many aspects of the current problems and study the social impact of these decisions.

■ MD45

Level 1 -101E

Sustainable Supply Chains

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Basak Kalkanci, Massachusetts Institute of Technology, Boston, MA, United States of America, kalkanci@MIT.EDU

1 - Optimal Planning of a Reverse-Logistics Supply Chain for a Consumer Electronics Retailer
Andre Calmon, Massachusetts Institue of Technology, 77 Massachusetts Avenue, E62-364, Cambridge, MA, 02139, United States of America, acalmon@mit.edu, Stephen C. Graves

We describe, model, and optimize the reverse logistics that support the warranty system used by a Fortune 100 company that sells consumer electronics. Since this company uses refurbished devices to satisfy warranty claims, their reverse logistics operation is also a closed-loop supply chain. Within this setting, our main contributions are: (i) Policies for managing inventory of refurbished devices in this system; (ii) An algorithm for assigning refurbished items in inventory to customers.

2 - Sales Force Compensation for Remanufactured Products
Jeremy Kovach, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, jeremy.kovach@scheller.gatech.edu, Atalay Atasu, Sumitro Banerjee

We investigate sales force management practices for a firm that engages in remanufacturing. The firm sells new and remanufactured products in the same market and incentivizes sales agents to increase demand. We determine the structure of the ideal compensation plans to be offered to the sales agents and how sales force incentives affect the profitability of remanufacturing.

3 - To Sell and to Provide? The Implications of the Auto Manufacturer's Involvement in Car Sharing
Ioannis Bellos, Assistant Professor, George Mason University, ISOM Area, 4400 University Drive MS 5F4, Fairfax, VA, 22030, United States of America, ibellos@gmu.edu, Beril Toktay, Mark Ferguson

In this paper we study the auto manufacturer's choice regarding whether to provide mobility service (e.g., car sharing) in conjunction with the traditional sales channel. We explicitly model the consumer's choice of transportation mode as well as vehicle usage decisions and we characterize the environmental and economic implications of the auto manufacturer's strategy.

4 - Measurement and Improvement of Environmental Performance under Voluntary versus Mandatory Disclosure
Basak Kalkanci, Massachusetts Institute of Technology, Boston, MA, United States of America, kalkanci@mit.edu, Erica Plambeck, Erjie Ang

When a firm exerts effort to evaluate its social & environmental impacts, it finds opportunities to reduce them (and hence its risks associated with future regulation). We investigate when a firm should learn and disclose its impact (accounting for the response from consumers and investors) and whether policy makers should mandate disclosure. Experimentally, we show that voluntary disclosure can boost sales.

■ MD46

Level 1 -101F

Managing Supply and Quality Risks

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Tim Noparumpa, Assistant Professor of Management, Providence College, School of Business, 1 Cunningham Square, Providence, RI, 02918, United States of America, tnoparum@providence.edu

1 - Supply Chain Partnerships with Both Uncertain Demand and Supply
Xuan Zhao, Associate Professor, Wilfrid Laurier University, 75 University Ave. W., Waterloo, On, N2J 3C5, Canada, xzhao@wlu.ca, Yong He

We consider an agriculture supply chain with an uncertain supplier selling to a retailer facing stochastic demand. The major questions we address are: how much production quantity should the supplier prepare for the selling season? How much inventory should the retailer order? What supply chain contract or partnership should the supplier and retailer engage in to induce the most efficient decisions of the supplier and the retailer? We investigate the equilibrium under a variety of partnerships.

2 - Price-setting Newsvendor Problems with Uncertain Supply and Risk Aversion
Scott Webster, Syracuse University, Whitman School of Management, 721 University Ave., Syracuse, NY, 13244, United States of America, stwebste@syr.edu, Burak Kazaz

The price-setting newsvendor problem, which models the economic tradeoffs associated with uncertain demand, is fundamental to supply chain analysis. However, in settings such as agriculture, there is significant economic risk associated with supply uncertainty. We extend technical advances in the literature to accommodate supply uncertainty and risk aversion.

3 - Are Incentives Enough? The Value of Audit in Managing Supplier's Process Improvement
Mohammad Nikoofal, PhD Student, McGill University, 1001 Sherbrooke Street West, Bronfman Building, Montreal, QC, H3A 1G5, Canada, mohammad.nikoofal@mail.mcgill.ca, Mehmet Gumus

Besides the benefits of outsourcing, firms are concerned about the lack of information regarding their suppliers. Moreover, suppliers may take certain actions that affect their supply risks without informing their buyers. We study the effectiveness of incentive- and audit-based contracts in dealing with such suppliers.

4 - What Fine Wine to Carry? The Influence of Weather on the Futures and Bottle Prices of Bordeaux Wines
Mert Hakan Hekimoglu, Syracuse University, Whitman School of Management, 721 University Ave., Syracuse, NY, 13244, United States of America, mhekimog@syr.edu, Burak Kazaz, Scott Webster

It is well known that weather influences the quality of wine; however, earlier studies have shown no impact on the price and quality indicator of en primeur Bordeaux wines. Using data from Liv-ex.com, we confirm this finding; however, complement the impact of changes in weather information influencing the futures price and bottle price of young en primeur Bordeaux wines.

5 - Wine Futures and Advance Selling under Quality Uncertainty
Tim Noparumpa, Assistant Professor of Management, Providence College, School of Business, 1 Cunningham Square, Providence, RI, 02918, United States of America, tnoparum@providence.edu, Burak Kazaz, Scott Webster

In this study we examine the use of wine futures and advance selling as a form of operational flexibility to mitigate quality rating risk in wine production. While aging in the barrel, expert reviewers create a barrel score, indicating the potential quality of the wine. Based on the barrel score, the wine producer determines what proportion of its wine should be sold as futures, and what proportion should be sold in retail.

■ MD47

Level 1 -101G

Design and Control of Service Operations

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Serhan Ziya, University of North Carolina, CB# 3260 356 Hanes Hall, Chapel Hill, NC, United States of America, ziya@unc.edu

1 - Selfish or Altruistic? The Impact of Customer Routing in a Self-service Queue
Hakjin Chung, PhD Candidate, University of Michigan, 710 Tappan St., Ann Arbor, MI, 48109, United States of America, hakjin@umich.edu, Hyun-Soo Ahn, Rhonda Righter

We consider a firm who can provide service in both full-service and self-service modes and examine how customer's selfishness to improve their own utility influences the optimal service rate for full service. We show that selfish routing increases the traffic toward the full service. Consequently, the provider tends to build a higher capacity than when customers self-regulate to increase the traffic.

2 - Diffusion Approximations for Chat Service Systems
Leon Cui, University of Rochester, 620 University Park, Rochester, 14620, United States of America, leon.cui@simon.rochester.edu, Tolga Tezcan

In this paper, we study a queueing model of customer service chat (CSC) systems. A unique feature of these queueing systems is that a single agent can serve multiple customers simultaneously. Under diffusion scaling, we prove the convergence of the queueing process to a simple stochastic differential equation in a many server heavy-traffic regime and use the result to estimate the number of customers in the system and the sojourn time of a customer.

3 - Managing Intensive Care Units (ICUs): Speedup vs. Admission Control
Galit Yom-Tov, Technion - Israel Institute of Technology, Technion City, Haifa, 32000, Israel, gality@techunix.technion.ac.il, Carri Chan

Due to uncertainty in the demands of critical patients, the ICU is often congested. Consequently, physicians have adopted a number of adaptive mechanisms–delayed admission, admission control, speedup, etc.–to manage access to ICU care. This work focuses on two primary mechanisms: speedup and admission control. We examine the tradeoff between speeding up service of current patients to increase access to care versus reducing new admissions to enable high quality care for admitted patients.

4 - Prioritization in Services when Customer Types are Unknown
Zhankun Sun, University of North Carolina, Chapel Hill, 2000 Baity Hill Dr, Apt. 215, Chapel Hill, NC, 27514, United States of America, szk@unc.edu, Nilay Tanik Argon, Serhan Ziya

We consider a service system with two types of customers. The type of each customer is unknown but the server has the option of performing triage and making an imperfect classification. Each customer incurs a linear waiting cost depending on its type. The server has to weigh the benefit of triage and prioritization under imperfect information against the cost of delay by triage. We characterize the optimal dynamic and static policies that minimize the expected cost.

■ MD48

Level 1 -101H

Certified Analytics Professional Program (CAP)

Cluster: INFORMS Communities

Invited Session

Chair: Louise Wehrle, Certification Manager, INFORMS, 5521 Research Park Drive, Suite 200, Catonsville, MD, 21228, United States of America, louise.wehrle@informs.org

1 - Certified Analytics Professional Program (CAP)

Louise Wehrle, Certification Manager, INFORMS, 5521 Research Park Drive, Suite 200, Catonsville, MD, 21228, United States of America, louise.wehrle@informs.org

Ever wonder how and why the CAP program was created? How were the exam questions selected? What are professional certification programs and why should you care? Join Dr. Wehrle, Certification Manager for INFORMS CAP to find out more about the first analytics professional certification program; its genesis, its creation and its direction for the future. Learn how you can write and contribute the your specific questions. Have your questions about CAP answered.

■ MD49

Level 1 -101I

Network Search from a Game Theoretic Viewpoint

Cluster: Tutorials

Invited Session

Chair: Steve Alpern, Professor, Warwick Business School, ORMS Group, Coventry, CV4 7AL, United Kingdom, steve.alpern@wbs.ac.uk

1 - Network Search from a Game Theoretic Viewpoint

Steve Alpern, Professor, Warwick Business School, ORMS Group, Coventry, CV4 7AL, United Kingdom, steve.alpern@wbs.ac.uk

A Searcher wishes to find an unknown point H (hidden by the Hider) on a given network Q. He starts from a known point O and moves at unit speed until the first time T (the Payoff) that he reaches H. The 'classical theory' begins in 1979 with the work of S. Gal for trees Q, and culminates with Gal's extension to weakly Eulerian networks in 2000. In between many other researchers contributed to the theory. We review the classical theory and present extensions in various directions.

■ MD50

Level 1 -101J

Energy II: Renewable Energy Generation

Contributed Session

Chair: Chung-Hsiao Wang, LG&E and KU, 102 Spruce Ln, Louisville, KY, 40207, United States of America, chunghsiao@hotmail.com

1 - Renewable Power Plant Repowering under Cost and Policy Uncertainties

Chung-Hsiao Wang, LG&E and KU, 102 Spruce Ln, Louisville, KY, 40207, United States of America, chunghsiao@hotmail.com, K. Jo Min, Chenlu Lou

We construct and analyze a renewable power producer's repowering decision model when the producer faces cost and policy uncertainties. Specifically, we assume that the operations and maintenance cost follows a Geometric Brownian Motion process and the production tax credit renewal/expiration follows a birth/death process. The resulting analyses lead to several managerial insights. For example, if the expiration rate increases, then repowering will be expedited.

2 - Regulation Energy Management in Renewable Integration Market with Non-Generation Resources

Yuping Huang, Ph.D. Student, West Virginia University, Mineral Resources Building RM152, West Virginia University, Morgantown, WV, 26505, United States of America, ypnghuang@gmail.com, Qipeng Phil Zheng, Andrew Liu

Renewable energy integration market regulated with the cooperation of ancillary service and non-generation resource imposes new operating requirements. We thus present a stochastic MILP model with risk controls to optimize energy generation and regulate available resources so as to protect system reliability. The effects of flexible ramping capacities, regulation service and non-generation resources on reducing power imbalance are discussed in details.

3 - A New Mathematical Programming Approach to Optimizing Wind Farm Layouts

Sarina Turner, University of Toronto, 5 King's College Rd., Toronto, Canada, sarina@mie.utoronto.ca, David Romero, Cristina Amon, Timothy Chan, Peter Zhang

The optimal placement of turbines in a wind farm is critical to the maximization of power production. We develop a new mathematical programming approach for wind farm layout optimization. We use Jensen's wake decay model to represent multi-turbine wake effects. We develop mixed integer linear and quadratic optimization formulations and apply them to several example layout cases in the literature. Compared to previous approaches, our models produce layouts that generate slightly more power.

4 - Optimization of Silicon Structures for Maximum Solar Cell Efficiency

Paul Leu, Assistant Professor, University of Pittsburgh, 1035 Benedum Hall, Pittsburgh, PA, 15261, United States of America, pleu@pitt.edu

Light trapping is important for reducing the amount of material in silicon solar cells, while maintaining absorption. Light trapping allows for not only the use of less silicon, but poorer quality silicon that can decrease costs substantially. In this talk, we discuss optimization of silicon structures for maximum solar absorption. We demonstrate how optimization methods may be integrated with electrodynamic simulations to screen various structures quickly and guide experiments.

5 - E-M Algorithm and Finite Mixture Model for Renewable Energy Applications

Yidong Peng, North Dakota State University, 2940 7th St. N., Apt 4, Fargo, ND, 58102, United States of America, yidong.peng@ndsu.edu, Jing Shi

We propose applying the finite mixture model in the renewable energy field, given the limited existing studies in literature and the promising potential of this methodology. We test various finite mixture models for estimating wind speed, wind power generation, and electricity price. The well-known E-M algorithm is used for model fitting. Our results show that the finite mixture models can provide accurate estimation for all these data, as well as capture the volatilities.

■ MD51

Level 1 -102D

Pedestrian and Bicycle Transportation Systems

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Jeffrey LaMondia, Assistant Professor, Auburn University, 238 Harbert Engineering Center, Auburn University, Auburn, AL, 36849, United States of America, jlamondia@auburn.edu

1 - GIS-based Construction of a Topographical Road Graph for Bicycle Tour Routes

Katherine Carl, Graduate Teaching Associate, University of Arizona, 825 E. 5th Street, Apt. 203A, Tucson, AZ, 85719, United States of America, kcarl@email.arizona.edu, Moshe Dror

This paper describes the algorithmic components of transforming road map data into an enhanced topographical road graph using polyline data from the OpenStreetMap, elevation data from a Digital Elevation Model, and a model of perceived exertion (PE) for bicyclists of different levels of expertise. The graph constructed allows for the calculation of the PE of any sequence of road segments for bicyclists of different levels of expertise and facilitates the construction of a path of minimal PE.

2 - Optimizing the Mobility and Safety of Walk-and-Ride Systems

Hugh Medal, Assistant Professor, Mississippi State University, 260 McCain Engineering Building, Mississippi State University, MS, 39762, United States of America, hugh.medal@msstate.edu, Xiaopeng Li

We study the problem of jointly locating sidewalks and bus shelters in order to maximize both mobility and safety for walk-and-ride transit users. Our models, which include both hub location and network design decisions, investigate two objectives: travel time and safety. We employ Benders's decomposition and branch-and-price strategies along with a fast heuristic. A set of computational experiments, using data from Starkville, MS, investigate the robustness and tractability of the models.

3 - Calibrating an Access-purpose Gravity Model for Cyclist Trip Distributions

Jeffrey LaMondia, Assistant Professor, Auburn University, 238 Harbert Engineering Center, Auburn University, Auburn, AL, 36849, United States of America, jlamondia@auburn.edu, Nathan Moore

Understanding where cyclists prefer to travel is a critical part of developing bicycle networks. This study uses trip diary records from the 2008 Chicago Travel Tracker Survey to calculate a scalable gravity model function to forecast cyclists' movements over a variety of trip purposes. The model includes a series of accessibility-characteristics, such as zone development and activity opportunities, elevation changes, traffic patterns, distances, and the existence of bicycle facilities.

■ MD52

Level 1 -102E

Stochastic Network Design

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Mike Hewitt, Assistant Professor, Loyola University Chicago, 1 E. Pearson, Chicago, IL, 60611, United States of America, mrheie@rit.edu

1 - Chance-constrained Reliable Network Design

Yongjia Song, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, ysong29@wisc.edu, James Luedtke

We study a chance-constrained model for the design of reliably connected networks. Speci?cally, given a graph with edges that may fail at random, we seek a minimum cost subset of edges such that the graph remains connected with high probability. Besides a scenario-based formulation with a branch-and-cut decomposition algorithm, we consider an alternative formulation based on a class of inequalities derived from extension of graph cuts to graphs with random failures.

2 - Designing Electric Power Grids to Minimize Cascading Blackouts

Eric Anderson, University of Wisconsin–Madison, Madison, WI, United States of America, eanderson4@wisc.edu, Jeff Linderoth

If an exogenous event impacts the topology or operating characteristics of an electric power grid, the currents reroute themselves according to the laws of physics. The change in flows may result in power lines reaching capacity, overloading, and eventually failing, further weakening the system. A sequence of failures in stages is known as a cascade. A multi-stage stochastic program with decision dependent uncertainty and a simulation-based-optimization approach will be discussed.

3 - Partial Decomposition Strategies for Two Stage Stochastic Integer Programs

Walter Rei, Professor, University of Quebec in Montreal, 315 St.Catherine Street East, Montreal, QC, H2X 3X2, Canada, rei.walter@uqam.ca, Teodor Gabriel Crainic, Mike Hewitt

The L-Shaped algorithm, which is based on Benders decomposition, is readily used to solve stochastic optimization models. However, to efficiently apply this method, one must overcome some of the drawbacks associated with the decomposition strategy. One of these drawbacks is related to the lack of information in the master problem due to the relaxation of the optimality and feasibility cuts. To address this problem, we propose a partial decomposition strategy that retains, throughout the solution process, part of the structure of the original model in the master problem. The benefits associated to this strategy are numerically illustrated on stochastic network design problems.

4 - A Local Branching based Decomposition Heuristic for Stochastic Programs

Walter Rei, Professor, University of Quebec in Montreal, 315 St.Catherine Street East, Montreal, QC, H2X 3X2, Canada, rei.walter@uqam.ca, Mike Hewitt, Teodor Gabriel Crainic

We propose a heuristic for scenario-based stochastic programs that decomposes the problem into a set of multi-scenario subproblems. To encourage consensus between solutions to the subproblems, solution information is shared across all subproblems and used to further restrict, using local branching strategies, the subproblems solved. We computationally study the effectiveness of the technique on instances of the stochastic network design problem.

■ MD53

Level 1 -102F

Freight Logistics I

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Srinivas Peeta, Professor, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47906, United States of America, peeta@purdue.edu

1 - Operation and Performance of a Last Mile Transportation System

Hai Wang, PhD candidate, Massachusetts Institute of Technology, 2D, 550 Memorial Drive, Cambridge, MA, 02139, United States of America, haiwang@mit.edu, Amedeo Odoni

We describe a model that considers a last mile transportation system as a batch arrival, batch service queueing system. We present an approach for deriving analytical expressions for some critical measures of system performance, as well as an analysis of an operating strategy.

2 - A Simulation Based Approach for Estimating Public Investment in US Freight Infrastructure

Yuntao Guo, Purdue University, 550 Stadium Mall Drive, School of Civil Engineering, West Lafayette, In, 47907, United States of America, guo187@purdue.edu

This study incorporates risk in total cost analysis to evaluate the public investment in US freight transportation infrastructure, in particular, the investment to support two competitive modes of freight transportation, long-haul trucking transportation and rail-truck intermodal transportation. A comparison between deterministic and risk based cost-benefit analysis provides insightful results on the economic and financial implications for the public interests.

3 - Freight Option-based Collaboration for Multiple Less-than-Truckload Carrier Logistics

Choungryeol Lee, Purdue University, 550 Stadium Mall Drive, School of Civil Engineering, West Lafayette, IN, 47906-2051, United States of America, lee1210@purdue.edu, Srinivas Peeta

We propose a theoretical framework for enabling collaborative multiple-carriers logistics in the less-than-truckload (LTL) industry. It is an option-based paradigm where LTL carriers autonomously hedge the risks faced in terms of capacity utilization and demand variability in an operational context. Numerical experiments illustrate that carrier-carrier collaboration with freight options has the potential to enhance the reliability and resilience of the LTL freight system.

4 - Integer Programming Formulations for Optimizing Throughput in the Hunter Valley Coal Chain

Mohsen Reisi, PhD Student, The University of Newcastle, University Drive, Callaghan, 2287, Australia, mohsen.reisi@uon.edu.au, Natashia Boland, Martin Savelsbergh

The Hunter Valley Coal Chain is the world's largest coal export operation. An IP formulation is introduced to find the optimal way of providing coal for customers minimizing the total delay. Next, an aggregated IP model is developed that contains fewer variables and breaks the symmetry inherent in the first model. Referring to Hall's marriage theorem, a large number of inequalities is required in the aggregated model, thus a separation algorithm is used to add those few that are violated.

■ MD54

Level 1 -103A

Real-Time Traffic Monitoring and Control

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Stephen Boyles, Assistant Professor, The University of Texas at Austin, 301 E Dean Keeton St., Stop C1761, Austin, TX, 78712, United States of America, sboyles@mail.utexas.edu

1 - High Occupancy/Toll Lane Pricing under Stochastic Demand

Stephen Boyles, Assistant Professor, The University of Texas at Austin, 301 E Dean Keeton St., Stop C1761, Austin, TX, 78712, United States of America, sboyles@mail.utexas.edu, Lauren Gardner, Hillel Bar-Gera

We consider and evaluate potential HOT lane pricing schemes, focusing on the issue of real-time pricing amidst uncertainty in demand and driver value of time. We conduct a set of experiments to demonstrate the impact that these stochastic factors have as their parameters vary.

2 - Design of Equitable Toll Prices for the High Occupancy Toll Lanes
Chaitanya Paleti, NexTRANS Research Center, Purdue University, 3000 Kent Avenue, West Lafayette, IN, United States of America, cpaletis@purdue.edu, Srinivas Peeta

Equity concerns associated with various pricing schemes in the domain of transportation systems have garnered increased attention in the recent past. We propose an income-based toll pricing approach to simultaneously maximize the toll revenue and address the income equity concerns in the context of HOT lanes. The problem is formulated as a bi-level program and agent-based modeling is used to determine the toll prices.

3 - A Probabilistic Stationary Speed-density Relation Based on Newell's Simplified Car-following Model
Saif Eddin Jabari, IBM, Yorktown Heights, NY, United States of America, sgjabari@us.ibm.com, Jianfeng Zheng, Henry X. Liu

This paper presents a method for deriving probabilistic macroscopic traffic flow relations from Newell's simplified car-following model. The probabilistic nature of the model allows investigating the impact of driver heterogeneity on macroscopic relations of traffic flow. The physical features of the model are verified analytically. An empirical study is carried out to obtain distributions of individual driver parameters and these are used to perform calculations with the probabilistic macroscopic relations.

4 - Real-time Link Travel Time Estimation using License-plate Recognition Data
Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, Xianyuan Zhan

License-plate recognition data from video cameras is an emerging data source in urban transportation system. Due to cost and privacy issues, limited research has been done to develop models for link travel time estimation using LPR data. In this study, a new methodology of utilizing LPR data to estimate intersection queueing delay and urban link travel times is proposed. Numerical experiments using LPR data from Qinghuangdao, China, is performed to validate the proposed model.

■ MD55

Level 1 -103B

Network Design and Emergencies

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Elise Miller-Hooks, University of Maryland, 1173 Glenn Martin Hall, Dept. of Civil & Env. Eng., College Park, MD, 20742, United States of America, elisemh@umd.edu

1 - The Effect of Surrogate Networks on the Interdependent Network Design Problem
Andres Gonzalez, Rice University, 6100 Main Street, MS-318, Dept. of Civil & Environmental Engineering, Houston, TX, 77005, United States of America, andres.gonzalez@rice.edu, Mauricio Sanchez-Silva, Leonardo Dueñas-Osorio, Camilo Gòmez, Andrés L. Medaglia

The main objective of the Interdependent Network Design Problem (INDP) is the efficient design of recovery strategies after a damaging event. In this work, we use the INDP to address the problem of reconstructing interconnected networks considering co-location and functional interdependencies. We also study the effects of using simplified surrogate networks on the quality and efficiency of the INDP solutions as a stepping stone towards better multi-system intervention decision support.

2 - Network Design for Disaster Relief Supply Chain
Keli Feng, Assistant Professor, South Carolina State University, 2190 Hoffman Dr, Orangeburg, SC, 29118, United States of America, kfeng1@scsu.edu

This research aims to develop a network design model to optimally locate emergency response facilities and minimize the total system-wide costs. The emergency response facilities include State Staging Area, Point of Distribution, and neighborhood locations. A mixed integer linear programming model is developed to solve this problem. A case study in the state of South Carolina is conducted to evaluate the applicability and efficiency of the model.

3 - The Role of Network Topology in the Resilience of Transportation Systems
Elise Miller-Hooks, University of Maryland, 1173 Glenn Martin Hall, Dept. of Civil & Env. Eng., College Park, MD, 20742, United States of America, elisemh@umd.edu, Kevin Denny, Xiaodong Zhang, Shabtai Issac

The role of a network's topology in its resilience to disaster events caused by a host of possible hazard types is studied herein. Insights gleened from results of systematically designed numerical experiments employing a developed modeling framework and appropriate adaptations to consider a variety of resilience measures provide a basis for the characterization of highly resilient network topologies and identification of network attributes that might lead to poorly performing systems.

4 - A Complex Network Analysis of Resiliency in Surface Transportation Networks
Abigail Osei-Asamoah, PhD. Student, University of Connecticut, 261 Glenbrook Road, Unit 3037, Storrs, CT, 06269, United States of America, abo09001@engr.uconn.edu, Nicholas Lownes

A complex network approach is used to analyze resiliency in surface transportation networks using examples of the CT US Highway and Interstate Network,Indiana Interurban RailRoad Network and the Swiss Rail Network. Critical thresholds for failure are established using complex network metrics and can contribute to preparedness,response,and recovery in disasters and emergencies. The study compares resiliency in some of the transportation networks to that of a biologically generated network.

■ MD56

Level 1 -103C

Optimization and Scheduling in Petroleum and Petrochemical industries – Supported by the Petrochemical and Petroleum Subgroup of ENRE

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Marlize Meyer, Principal Operations Researcher, Sasol Technology, 1 Klasie Havenga str, Sasolburg, 1947, South Africa, marlize.meyer@sasol.com

1 - Distributive Recursion LP in Refining
Margery Connor, Chevron, 6001 Bollinger Cyn Rd., San Ramon, CA, 94583, United States of America, MHCO@chevron.com

Chevron will present how they are using distributive recursion in their refinery planning tool

2 - A Decomposition Approach to Solve Network Design Problem in Packaged Gases
Tejinder Pal Singh, Research Scientist, Air Liquide, 12800 W. Little York Rd., Houston, TX, 77041, United States of America, tejinder.singh@airliquide.com, Michele Quattrone

Network design problems can be very large-scale and need approximation approaches to solve them. Network Configuration in packages gases is a strategic decision that impacts the tactical delivery planning and daily scheduling and transportation operations. We develop a decomposition approach to solve the network design problem which has multiple objectives related to location of plants and their capacities, stock and resources management.

3 - A Risk Analysis Study of the Negative Pressure Test in Oil and Gas Drilling
Maryam Tabibzadeh, Ms., University of Southern California, 1157 W. 30th St., Los Angeles, CA, 90007, United States of America, m.tabibzadeh@gmail.com, Najmedin Meshkati

This paper introduces a Bayesian network modeling as a major part of a risk assessment framework for analysis of the Negative Pressure Test (NPT), which is a critical step in well integrity during offshore drilling. This framework focuses on the critical role of human and organizational factors in conducting and interpreting NPT. Although this study is based on the analyses and lessons learned from the BP Deepwater Horizon accident, it is applicable for risk analysis of future drillings as well.

■ MD57

Level 1 -103D

Renewable Energy and Biofuel Supply Chain

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Guiping Hu, Iowa State University, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu

1 - A Bottom-up Biofuel Market Equilibrium Model for Policy Analysis

Leilei Zhang, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, leileizh@iastate.edu, Guiping Hu, Lizhi Wang, Yihsu Chen

A bottom-up equilibrium model is developed to investigate the supply chain of the biofuel market, and the interaction among farmers, producers, blenders, and consumers in the market. The model simultaneously maximize the profits of all entities in the biofuel market by incorporating the decisions in farmer's land allocation, biomass and biofuel transportation, biofuel production and blending. The structure of the model enables us to study the impact of different policies on the market outcome.

2 - Sequential Facility Location-allocation for Fast Pyrolysis Biofuel Production Network

Yihua Li, Iowa State University, Ames, IA, United States of America, yihuali@iastate.edu, Guiping Hu

The revised Renewable Fuel Standard mandates the U.S. to consume 16 BGY of cellulosic biofuel by 2022. Fast pyrolysis is a thermochemical process to produce liquid transportation fuels from cellulosic biomass. A sequential facility siting problem is formulated to optimize an orderly fast pyrolysis facility location and capacity that maximize the net present value (NPV) of the total profit during the next 10 years (2013-2022). Numerical examples based on a case study for Iowa are also presented.

3 - Optimizing Locations for Ocean Wave Energy Farms under Uncertainty

Lawrence V. Snyder, Associate Professor, Lehigh University, 200 West Packer Ave., Mohler Lab, Bethlehem, PA, 18015, United States of America, larry.snyder@lehigh.edu, Lizhou Mao

Our models seek optimal locations of ocean wave-energy conversion (WEC) devices within a wave farm under uncertainty, accounting for the hydrodynamic interactions between ocean waves and the WECs. We obtain solutions that are significantly more robust than those in the literature, which perform poorly when the wave environment changes only slightly. We also discuss qualitative results concerning how the optimal layouts change as the ocean characteristics change.

4 - Efficient Algorithms and Policies for Demand Response Scheduling

Fang Chen, Ph.D. student, Lehigh University, 6625 Alamo Ave., Apt. 2E, Clayton, MO, 65201, United States of America, fac210@lehigh.edu, Lawrence V. Snyder, Shalinee Kishore

We model the optimization problem for an Energy Management Controller, which optimizes the power consumption within a facility or set of facilities by scheduling the timing of the operation of some of the devices within the facilities. We introduce an Approximate Dynamic Programming (ADP) algorithm for this problem and show that the ADP outperforms an existing dynamic programming algorithm. We then propose several scheduling policies that provide good solutions extremely quickly.

■ MD58

Level 1 -103E

Demand Response and Load Aggregation in Electricity Markets

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Ross Baldick, University of Texas at Austin, PO Box 4216, Austin, TX, United States of America, baldick@ece.utexas.edu

Chair: Mahdi Kefayati, Research Assistant, The University of Texas at Austin, 2501 Speedway ENS 506A, Austin, TX, 78712, United States of America, kefayati@utexas.edu

1 - Power System Dynamics as Primal-dual Algorithm for Optimal Load Control

Steven Low, California Institute of Technology, MC 305-16, Pasadena, CA, United States of America, slow@caltech.edu, Changhong Zhao, Ufuk Topcu, Na Li

We formulate an optimal load control (OLC) problem in power networks, where the objective is to minimize the aggregate cost of tracking an operating point subject to power balance over the network. We prove that the system dynamics coupled with frequency-based load control serve as a primal-dual algorithm to solve OLC. This result implies that the local bus frequencies convey the right information for the loads to make individual decisions, which allows a decentralized solution.

2 - Risk-aware Scheduling and Real-time Charging for Plug-in Electric Vehicles

Lei Yang, Postdoc Researcher, Arizona State University, Tempe, AZ, 85287, United States of America, lyang55@asu.edu, Vincent Poor, Junshan Zhang

Risk-aware scheduling and real-time charging for electric vehicle (EV) is studied. The aim is to optimize jointly the EV charging cost and the load mismatch risk between the forecast EV load and the actual load due to EVs' random driving activities. To mitigate the computational complexity resulting from the large number of EVs in the system, an estimation algorithm based on importance sampling is developed, which can reduce the overall charging cost by using only a small number of samples.

3 - Multi-stage Stochastic Decision Making Framework for Providing Ancillary Services with Active Demand

Mahnoosh Alizadeh, University of California Davis, 644 Alvarado Ave., Davis, CA, 95616, United States of America, malizadeh@ucdavis.edu, Anna Scaglione

We present an integrated decision making framework for a load serving entity providing ancillary services to the wholesale electricity market.The multi-settlement market structure induces an interdependence among strategic decisions made at different time stages.To model dynamics of demand when making decisions,we propose a classification-based model that captures the effect of individual appliance loads at aggregate levels,with reasonable effort.Electric Vehicles are showcased as an example.

4 - Scheduling Flexible Loads in Multi-settlement Electricity Markets

Mahdi Kefayati, Research Assistant, The University of Texas at Austin, 2501 Speedway ENS 506A, Austin, TX, 78712, United States of America, kefayati@utexas.edu, Ross Baldick

We consider the decision making problem of a Load Aggregator which buys energy and sells ancillary services on behalf of a group of flexible loads (e.g. Electric Vehicles) in a multi-settlement market. Taking an stochastic optimization approach, we propose a model that captures the interdependence of decisions and propose a data driven scenario generation method that enables effective representation of uncertainty. Finally, Electric Vehicle load scheduling is demonstrated as a case study.

■ MD59

Level 1 -103F

Integrating Sustainability into Operational Decisions

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Arda Yenipazarli, Assistant Professor, Georgia Southern University, College of Business Administration, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

1 - Competing on Capacity: Can Green and Brown Products Coexist?

Arda Yenipazarli, Assistant Professor, Georgia Southern University, College of Business Administration, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

This paper attempts to enrich the product variety management problem by providing an operations and a marketing perspective through a focus on green products and on factors related to the demand of a segmented consumer market (by their involvement in green values and purchasing) faced by a firm with limited production capacity. We identify the profitability conditions for expanding the product line with a green product by considering the distinctive characteristics of green products.

2 - Reverse Channel Design and Remanufacturing Strategies

Lan Wang, Student, University of Florida, University of Florida, STZ 355B, Gainesville, Fl, 32611-7169, United States of America, lan.wang@warrington.ufl.edu, Divakar Rajamani, Asoo Vakharia, Tharanga rajapakshe

We examine the reverse channel design decision by focusing on three strategies (a) in-house; (b) third party; and a (c) hybrid strategy. Our analysis considers the demand side impact of cannibalization of new products; the supply side impact of uncertain yield; and the stage of the product life cycle.

3 - A Sustainable Continuous Review Inventory Control Model

Dincer Konur, Assistant Professor, Missouri University of Science and Technology, 206 EMSE, 600 W. 14th Street, Rolla, MO, 65409, United States of America, konurd@mst.edu, Brian Schaefer

This study formulates a bi-objective continuous review inventory control system where expected costs and carbon emissions are minimized. We propose Pareto Front approximation and min-max formulation as solution approaches. Numerical studies demonstrate the effects of demand variance and lead time on carbon emissions. Furthermore, we discuss that emissions can be reduced without significant cost increase by integrating sustainability in continuous review inventory control systems.

■ MD60

Mezzanine - 100A

Joint DM/ICS: Statistical Modeling in Complex Optimization Problems

Sponsor: Data Mining

Sponsored Session

Chair: Victoria C Chen, The University of Texas at Arlington, Dept. of Indus. & Manufac. Sys. Engr., Arlington, TX, 76019, United States of America, vchen@uta.edu

Co-Chair: Jay Rosenberger, Associate Professor, The University of Texas at Arlington, PO Box 19017, Arlington, TX, 76019-0017, United States of America, jrosenbe@uta.edu

1 - A Comparison of MARS and SLAM in Approximate Optimization Problems

Danilo Macciö, National Research Council / CNR-ISSIA, Via De Marini 6, Genova, GE, 16149, Italy, danilo.maccio@cnr.it, Diana Martinez, Victoria C Chen, Cristiano Cervellera

The problem of numerically minimizing a functional cost typically involves the following two issues: (i) the choice of a class of models to approximate the solution; (ii) the definition of a sampling of the domain where the functional is evaluated. This work presents a comparison of performances given by two efficient techniques for function estimation, namely Multi-Adaptive Regression Spline (MARS) and Semi-Local Approximate Minimization (SLAM) in different functional optimization contexts.

2 - Adaptive Dynamic Programming to Control the Environmental Impact of Airport Deicing

Zirun Zhang, The University of Texas at Arlington, Dept. of Indus. & Manufac. Sys. Engr., Arlington, TX, 76011, United States of America, zirun.zhang@mavs.uta.edu, Jay Rosenberger, Victoria C Chen, Dan Bergman, Li Zeng

An adaptive dynamic programming (ADP) approach for assigning aircrafts to deicing pad locations at the Dallas-Fort Worth International Airport is developed to minimize the impact on dissolved oxygen (DO) in receiving waters. In this stochastic, finite-horizon, non-stationary, non-convex, and very high dimensional ADP problem, future value functions are statistically modeled and a mixed integer linear programming problem is formulated within each stage to maintain DO in current and future stages.

3 - Optimal Bayesian and Sequential Experimental Design using Approximate Dynamic Programming

Xun Huan, Massachusetts Institute of Technology, 77 Massachusetts Ave., 37-442, Cambridge, MA, 02139, United States of America, xunhuan@mit.edu, Youssef Marzouk

How can one select a sequence of experiments to maximize the value of costly experimental data? We formulate this optimal sequential experimental design problem in a POMDP framework, maximizing the expected information gain. Two major numerical issues are addressed: the representation of posterior distributions in a sequential Bayesian inference context, and the choice of features in value function approximation for ADP. Preliminary results are demonstrated on model problems and applications.

4 - Global Optimization of Non-convex Piecewise Linear Regression Splines

Nadia Martinez, The University of Texas at Arlington, PO Box 19017, Arlington, TX, 76019, United States of America, nadia.martinezcepeda@mavs.uta.edu, Jay Rosenberger, Victoria C Chen, Diana Martinez

This research presents a branch-and-bound algorithm to optimize a non-convex piecewise linear function generated by a modified version of Multivariate Adaptive Regression Spline (MARS) subject to constraints that include both linear regression models and piecewise linear MARS models. The method proposed is illustrated in an automotive crash safety system design case study and compared with an evolutionary optimization algorithm.

■ MD61

Mezzanine - 100B

Classifier Ensembles Generation Methods

Sponsor: Data Mining

Sponsored Session

Chair: Senay Yasar Saglam, PhD Candidate, The University of Iowa, Depatment of Management Sciences, S210 John Pappajohn Business Building, Iowa City, IA, 52242, United States of America, senay-yasarsaglam@uiowa.edu

1 - Dynamic Ensemble Prediction with a Classifier-based Distance Metric

Senay Yasar Saglam, PhD Candidate, The University of Iowa, Depatment of Management Sciences, S210 John Pappajohn Business Building, Iowa City, IA, 52242, United States of America, senay-yasarsaglam@uiowa.edu, Nick Street

We propose a system for ensemble classification based on a new distance measure between data points. We map data points into a space defined by the class probability estimates from a pool of two-class classifiers. We define the new distance measure to be the Euclidean distance between data points in this space. We dynamically pick classifiers (features) to be used and the k-nearest neighbors of a test point by minimizing the distance between the neighbors and the test point.

2 - A Machine-learning Technique for the Prediction of Equity Price Direction

Michael Rechenthin, University of Iowa, Management Science, Iowa City, IA, United States of America, michael-rechenthin@uiowa.edu, Nick Street

We present machine learning techniques to anticipate future directional price moves in stocks in the very short term. Historical price data and technical analysis indicators are used to build thousands of classifiers that are then employed in dynamically-constructed ensembles across different stocks. These predictors update automatically to adjust for changing market conditions and can help traders better make more informed trading decisions.

3 - Integer Programming for Instance Selection in Supervised Learning

Walter Bennette, Student, Iowa State University, Industrial and Manufacturing Systems Eng, 3004 Black Engineering, Ames, IA, 50011, United States of America, bennette@iastate.edu, Sigurdur Olafsson

Aspects of a classifier's training dataset may negatively affect the ability of the classification algorithm to induce an accurate classifier. For example, class values may overlap, classes may have outliers, or minority classes may be ignored. We will introduce instance selection techniques that utilize integer programming to select a subset of the data in such a way that all or some classification learning algorithms will perform better when applied to the new and reduced training dataset.

■ MD62

Mezzanine - 100C

Reliability and Quality in Emerging Technology and Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Tongdan Jin, Associate Professor, Texas State University, 601 University Drive, San Marcos, United States of America, tj17@txstate.edu

Co-Chair: Zhigang Tian, Concordia Institute for Information Systems Engineering, Faculty of Engineering and Computer Science, Concordia University, Montreal, Quebec, Canada, tian@ciise.concordia.ca

1 - System Reliability Prediction based on Component-level Prognostics Information

Zhigang Tian, tian@ciise.concordia.ca

Prognostics can be performed directly for individual components. However, failure time of an individual system can not be predicted directly based on the component prognostics information. In this work, we propose a system reliability analysis framework and methods based on component prognostics information. A method is presented to evaluate system failure time distribution based on predicted component failure time distributions.

2 - Joint Optimization of X Control Chart and Preventive Maintenance Policies: A Discrete-Time Markov

Yisha Xiang, Sun Yat-Sen University, Guangzhou, China, xiangysh@mail.sysu.edu.cn, Tongdan Jin

Process control and maintenance planning have long been treated as two separate problems. The interdependence between these two activities has not been adequately addressed in the literature, despite their apparent connections. The proposed model is developed for a production process that deteriorates according to a discrete-time Markov chain. A numerical example is used to illustrate the proposed integrated process control and preventive maintenance policies.

3 - Reliability Mapping of Remanufactured Products

Wilkistar Otieno, Assistant Professor, University of Wisconsin, 3200 N. Cramer St., RM 503, Milwaukee, WI, 53211, United States of America, otieno@uwm.edu, Thomas Omwando

Remanufacturing is becoming popular as a disposal option for products at the end of their first-life. This is due to stringent environmental legislation and the relative economic benefits of product take-back. Challenges of remanufacturing include the determination of quality, cost and warranty estimates all of which are dependent on product reliability estimates. We present a simulation model that maps product reliability considering components with varying age distributions and residual life.

■ MD63

Mezzanine - 100D

Nanomaterial Process Modeling and Analysis

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Chiwoo Park, Assistant Professor, Florida State University, 2525 Pottsdamer St., Tallahassee, FL, 32310-6046, United States of America, cpark5@fsu.edu

1 - Fast Compartmental MC Simulation of Population Balance Models: Application to Nanoparticle Formation

Roberto Irizarry, DuPont Electronic Technologies, Circleville, OH, United States of America, Roberto.Irizarry@dupont.com

A compartmental Monte Carlo (CMC) algorithm is introduced for the simulation of nanoparticle formation in spatially heterogeneous systems. The CMC is utilized to study large reactors using compartment models to simulate the fluid flow. The CMC ability to track single events was utilized to study the impact of highly turbulent zones on the final particle size distribution. The computational speed of this algorithm allows the solution of problems that may be intractable otherwise.

2 - Nanorod Length Estimation by Fusing Projection and Orientation Data

Abhishek Shrivastava, Assistant Professor, Florida State University, 2525 Pottsdamer Street, Tallahassee, FL, 32310, United States of America, shrivastava.abhishek.k@gmail.com, Chiwoo Park

Accurate and precise estimates of nanostructure dimensions are a prerequisite to use of quality engineering tools. In this talk we present a method for estimating lengths of nanorods grown in arrays. We obtain nanorod length projections from an electron micrograph and their orientation information using polarized Raman spectroscopy. We propose a statistical model to fuse this information. We will demonstrate the efficacy of the model using simulations, and a real case study.

3 - Coagulation and Aggregation in High Temperature Aerosol Synthesis Reactors

Chris Hogan, Assistant Professor, University of Minnesota, 111 Church St. SE, 103 Mechanical Engineering, Minneapolis, MN, 55455, United States of America, hogan@me.umn.edu, Thaseem Thajudeen, Hui Ouyang, Ranganathan Gopalakrishnan

High temperature reactors can be used for the production of nanomaterials in scalable quantities from vapor phase precursors. In such systems nanoparticles grow via collisions, and collisions govern the produced nanomaterial size distribution function. Through mean first passage time calculations we show that the collision rate coefficient accounting for nonspherical particle geometries and particle-particle interactions can be described through a simple dimensionless equation.

4 - Analysis of Nanoparticle Self-assembly Processes

Chiwoo Park, Assistant Professor, Florida State University, 2525 Pottsdamer St., Tallahassee, FL, 32310-6046, United States of America, cpark5@fsu.edu, Taylor Woehl, James Evans, Nigel Browning

Precise morphology control of nanoparticles requires a full understanding of the nanoparticle growth mechanism. Recently, in-situ electron microscopy has shown promise for the direct observations of nanoparticle growth, but analyzing a large amount of in-situ observations is challenging. We present a method for analyzing the in-situ observations to determine the key characteristics of nanoparticle growth processes, growth/aggregation rates, and particle size distribution as a function of time.

■ MD64

Mezzanine - 100E

Decision Support Systems

Contributed Session

Chair: Behrooz Kamali, PhD Candidate, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA, 24061, United States of America, kamali@vt.edu

1 - Reserving Operating Room Capacity for High Urgency Patients

Michael Samudra, KU Leuven, Naamsestraat 69 - bus 3555, Leuven, 3000, Belgium, samudra@kuleuven.be, Erik Demeulemeester, Brecht Cardoen

It is a general problem in hospitals that the exact time future high urgency patients will be arriving to a hospital is unknown in advance. This makes it necessary to reserve some amount of buffer capacity for them. Reserving too much capacity results in underutilized ORs whereas reserving too little capacity leaves many patients served too late. We are testing different reservation strategies using the data and the managerial insights from one the Belgium's largest hospitals.

2 - Covering-routing Problem Considering Maximum Returns to Critical Areas with GRASP

Maria José P. Lamosa, Dr., IEAv/CTA, Trevo Cel Av. José A. A. do Amarante, 1, São José dos Campos, SP, 12228-001, Brazil, maju@ieav.cta.br, Mônica Maria De Marchi, Daniel Merli Lamosa

The problem treated in this work consists in determining routes with minimum cost and maximum returns to some areas considered critical. In previous work, we presented methodologies using the multi-objective formulation to solve the problem. In this work, the multi-objective GRASP is proposed and results are presented. As application, the results could be used to support the decision making in scenarios where monitoring is required such as disaster management and airspace surveillance systems.

3 - Optimal Email Routing in a Multi-Channel Call Center

Oualid Jouini, Ecole Centrale Paris, Laboratoire Genie Industriel, Paris, France, oualid.jouini@ecp.fr, Benjamin Legros, Ger Koole

We consider a blended call center with calls and emails. The call service is characterized by three successive stages where the second one is a break, i.e., there is no required interaction between the customer and the agent. This leads to a new opportunity to efficiently split the agent time between calls and emails. We focus on the optimization of the email routing to agents. Our objective is to maximize the throughput of emails subject to a constraint on the call waiting time.

4 - What Does a Military Capability Cost?

Mark Rempel, Defence Scientist, Defence Research and Development Canada, 101 Colonel By Dr., Ottawa, Canada, mark.rempel@drdc-rddc.gc.ca

This paper presents a novel method for calculating military capability costs. Using time-driven activity-based costing, capability costs are calculated by attributing force structure costs to capabilities using training activities. Examples are discussed that highlight unique aspects of force structures, and show how to address these using capacity cost rates. This method provides a transparent method to calculate capability costs, and is a critical element for capability portfolio analysis.

5 - Decision Support for Patient Triage in Mass Casualty Incidents: A Risk-based Optimization Approach

Behrooz Kamali, PhD Candidate, Virginia Tech, 250 Durham Hall (0118), Blacksburg, VA, 24061, United States of America, kamali@vt.edu, Douglas Bish

Our research is the first to systematically coordinate the regional response to a mass-casualty event. We developed an integrated optimization model that simultaneously solves prioritization of patients, ambulance routing, and hospital surge capacity planning. Using developed models, we propose response plans that reduce casualty risk by effectively using resources to triage and transport of casualties to hospitals. Pediatric casualties, who require special triage and care, are also considered.

■ MD65

Mezzanine - 100F

Virtual Communities and Collective Action

Cluster: Social Media Analysis

Invited Session

Chair: Dipak Gupta, Professor, San Diego State University, 5500 Campanile Drive, NH-121, Department of Political Science, San Diego, CA, 92182-4427, United States of America, dgupta@mail.sdsu.edu

1 - Using Probabilistic Soft Logic (PSL) to Model Group Behavior in Collective Action

Bert Huang, University of Maryland, College Park MD, United States of America, Lise Getoor

Probabilistic soft logic (PSL) is a rich modeling framework that supports data-driven discovery of patterns of interaction in social media. The use of PSL to model collective behaviors in civil unrest and election events shows how different groups frame events and develop relationships between them.

2 - Tracking Political Extremists through the Web: The Case of White Extremist Movement

Jean Mark Gawron, Professor, San Diego State University, San DIego, CA, United States of America, gawron@mail.sdsu.edu, Dipak Gupta, Brian Spitzberg, Kellen Stevens, Ming Hsiang Tsou, An Li

These days political extremism is spreading through the Internet, by creating virtual communities various extremist groups attempt to recruit new members. This paper combines linguistic tools with the insights of social psychology to develops a new methodology for understanding how these movements gain strength of they disappear.

3 - Modeling Memetic Diffusion: Toward an Integrative Predictive Model

Brian Spitzberg, Professor, San Diego State University, San Diego, CA, United States of America, spitz@mail.sdsu.edu

Big data are being mined extensively, but there is little theory to guide such investigations. This presentation outlines a nested, multi-level model that adapts several theories to the task of providing a flexible yet predictive conceptual framework and vocabulary for these investigations.

4 - A Paradigm Shift in Data Analyses and Interpretation

Dipak Gupta, Professor, San Diego State University, 5500 Campanile Drive, NH-121, Department of Political Science, San Diego, CA, 92182-4427, United States of America, dgupta@mail.sdsu.edu, Brian Spitzberg, Ming Hsiang Tsou, Jean Mark Gawron, An Li

A paradigm shift is taking place in our understanding of the society that not only changes the analytical methodology but also calls for a thorough change in academic disciplinary boundaries. This article takes a comprehensive look the promises and pitfalls of this emerging field of inquiry.

■ MD66

Mezzanine - 100G

Economics of Information Systems

Sponsor: Information Systems

Sponsored Session

Chair: Marius Florin Niculescu, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree St. NW, Atlanta, GA, 30308, United States of America, Marius.Niculescu@scheller.gatech.edu

1 - Motivating User Contributions to Online Communities: A Structural Hidden Markov Model

Wei Chen, University of California-San Diego, Rady School of Management, San Diego, CA, United States of America, Wei.Chen@rady.ucsd.edu, Xiahua Wei, Kevin Zhu

This study develops a structural hidden Markov model (HMM) to understand user contributions to online communities. Using a public goods framework, our structural HMM model characterizes the dynamics of user contributions and investigates the effectiveness of different motivation mechanisms. We estimate the model with data from a knowledge sharing platform StackExchange.com. Counter-factual experiments from our model provide insights into designing effective mechanisms.

2 - Cardinality Bundles for Spence-Mirrlees Reservation Prices

Jianqing Wu, Purdue Univercity, 403 W. State Street, Room 412, W Lafayette, IN, 47907, United States of America, wu35@purdue.edu, Mohit Tawarmalani, Karthik Kannan

We develop optimal prices for cardinality bundling (CB) when customers are ordered by their preferences. In CB, the price depends on the number but not on the specific goods purchased; e.g., when songs are sold with CB, consumers may choose any songs up to the specified number. We develop polynomial time algorithms for various cost structures assuming that a customer purchases at most one bundle. Subsequently, we relax this assumption and study the impact of this assumption on seller profits.

3 - A Real Option Approach for Make-and-Sell-or-Buy Decisions of Web Services

Marcel Mueller, Research Assistant, University of Innsbruck, Universit%otsstrafle 15, Innsbruck, 6020, Austria, marcel.mueller@uibk.ac.at, Steffen Zimmermann, Bernd Heinrich

Characteristics of web services like loose coupling and standardized interfaces give non-software firms the option to sell internally developed web services on the web service market. We propose an analytical and a simulation model based on real options theory to value such a sell option ex-ante and enhance traditional make-or-buy approaches to a make-and-sell-or-buy approach for web services. Thereby, we reveal that this option may have considerable impact on traditional make-or-buy-decisions.

4 - Economics of Free under Perpetual Licensing: Implications for the Software Industry

Marius Florin Niculescu, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree St. NW, Atlanta, GA, 30308, United States of America, Marius.Niculescu@scheller.gatech.edu, DJ Wu

In this paper, we explore the economics of free under perpetual licensing for modular software. We focus on two emerging software business models: feature-limited freemium and seeding. We benchmark their performance against a conventional business model under which software is sold without free offers. Our model accounts for WOM effects and cross-module synergies. Our analysis uncovers conditions under which freemium and seeding are the dominating models under both constant and dynamic pricing.

■ MD67

Mezzanine - 100H

Decision Analysis Society Awards

Sponsor: Decision Analysis

Sponsored Session

Chair: Jeffrey Keisler, Professor, University of Massachusetts Boston, Boston, MA, United States of America, jeff.keisler@umb.edu

1 - 2013 Decision Analysis Student Paper Award

Lea Deleris, IBM, Paris, 75015, France, lea.deleris@ie.ibm.com, Jun Zhuang

The Student Paper Award is given annually to the best decision analysis paper by a student author, as judged by a panel of the Decision Analysis Society of INFORMS. Students who did not complete their Ph.D. prior to May 1, 2012 are eligible for this year's competition.

2 - 2013 Decision Analysis Practice Award

Frank Koch, Koch Decision Consulting, 2510 Cleveland St., Eugene, OR, 97405, United States of America, frank@kochdecisions.com

The Decision Analysis Practice Award is awarded to the best example of decision analysis practice as judged by the decision analysis practice committee. The purpose of the award is to publicize and encourage outstanding applications of decision analysis practice. Of the many quality example of applications submitted to the award committee, three examples of excellent applications were invited to present in the fall INFORMS meeting. The winner of the award was chosen from these finalists.

3 - 2013 Ramsey Medal Award

James Dyer, University of Texas at Austin, CBA 3.218, Austin, TX, 78712, United States of America, Jim.Dyer@mccombs.utexas.edu

The Ramsey Medal of the Decision Analysis Society is awarded for distinguished contributions in decision analysis. Distinguished contributions can be internal, such as theoretical and procedural advances in decision analysis, or external, such as developing or spreading decision analysis in new fields. We will introduce the 2013 Ramsey Medal winner, followed by a presentation by the winner.

4 - 2013 Decision Analysis Publication Award
Canan Ulu, University of Texas at Austin, McCombs School of Business, Austin, TX, United States of America, Canan.Ulu@mccombs.utexas.edu, Robin Dillon-Merrill, Robert Bordley, John Butler

This award is given annually to the best decision analysis article or book published in the second preceding calendar year (i.e. calendar year 2011 for consideration in 2013). The intent of the award is to recognize the best publication in "decision analysis, broadly defined." This includes, but is not limited to, theoretical work on decision analysis methodology (including behavioral decision making and non-expected utility theory), descriptions of applications, and experimental studies.

■ MD68

Mezzanine - 100I

Flexible Decision Making

Sponsor: Decision Analysis

Sponsored Session

Chair: KiHyung Kim, Purdue University, School of Industrial Engineering Purdue, 315 N. Grant Street, West Lafayette, IN, 47907-2023, United States of America, kim1151@purdue.edu

1 - Application of Adaptive Network Design to Transit Fare Revenue Management
Joseph Chow, Assistant Professor, Ryerson University, 350 Victoria Street, Toronto, ON, M5B 2K3, Canada, joseph.chow@ryerson.ca, Anchor Chin

An overview and review is given of the adaptive network design problem using approximate dynamic programming based on a real option solution method. Key research problems are highlighted, and feasibility of an application to transit fare revenue management with demand response is considered.

2 - The Relational Advantages of Intermediation
Elena Belavina, Assistant Professor, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60611, United States of America, Elena.Belavina@chicagobooth.edu, Karan Girotra

This paper provides a novel explanation for the use of supply chain intermediaries. We find that even in the absence of the well-known transactional and informational advantages of mediation, intermediaries improve supply chain performance. In particular, intermediaries facilitate responsive adaptation of the buyers' supplier base to their changing needs while simultaneously ensuring that suppliers behave as if they had long- term sourcing commitments from buying firms.

3 - Optimal Investment Time in Mining Projects under Uncertainty and Competition
Leonardo Santiago, Associate Professor, Federal University of Minas Gerais, Escola de Engenharia da UFMG, Av. Antönio Carlos, 6627 - Pampulha, Belo Horizonte, MG, 31270-901, Brazil, lsantiago@ufmg.br, Alexandre Rodrigues

We assess the managerial flexibility in competitive markets under uncertain demand. Our model takes into account the fact that the investment decision of a firm affects not only its profit, but also the profit of its competitors. Our focus is on analyzing investments of capacity expansion of mining projects.

4 - Copulas-based Dependent Decision Lattice Approach
Tianyang Wang, Assistant Professor, Colorado State University, Finance and Real Estate Department, Fort Collins, CO, United States of America, tianyang.wang@business.colostate.edu, Joe Hahn, James Dyer

In this paper we present a general framework of a copulas-based dependent decision lattice approach for correlated uncertainties. The proposed dependent decision lattice model allows multiple dependent uncertainties with arbitrary marginal distributions to be represented in a recombining tree structure. This general framework significantly reduce the size of the tree for practical applications in decision analysis, real options valuations, and financial derivatives valuation.

5 - Optimal Design of Flexible Systems with Exercising Delay
KiHyung Kim, Purdue University, School of Industrial Engineering Purdue, 315 N. Grant Street, West Lafayette, IN, 47907-2023, United States of America, kim1151@purdue.edu, Brandon Pope, Abhijit Deshmukh

Although the optimal control of flexible systems has received considerable attention, the optimal design of flexible systems remains in question. This paper focuses on the design problem by explicitly considering an oft-neglected aspect of flexibility, the exercising delay. We model the control of a flexible system as a delayed optimal stopping time problem, and solve the designer's problem of creating an optimally flexible system.

■ MD69

Mezzanine - 100J

Topics in Decision Analysis

Contributed Session

Chair: Prem Swaroop, PhD Candidate, University of Maryland, RH Smith School of Business, College Park, MD, 20742, United States of America, pswaroop@rhsmith.umd.edu

1 - Individual-Level Models for User Behavior and Its Effectiveness on Social Media
Prem Swaroop, PhD Candidate, University of Maryland, RH Smith School of Business, College Park, MD, 20742, United States of America, pswaroop@rhsmith.umd.edu, Yogesh Joshi, William Rand, Louiqa Raschid

Social media users have multiple communication modalities to increase their influence. We study three key influence measures: followership, diffusion of self-created content, and brand recognition. We present models which experiment with a range of modalities of user actions and study their impact on the influence outcomes. We find there are distict and varied drivers for each of the influence outcomes. This allows a user to customize her behavior on social media to impact specific outcomes.

■ MD70

Mezzanine - 101A

Joint Session AAS/TSL: Trajectory Control Models for Improving National Airspace System Performance

Sponsor: Aviation Applications & Transportation Science & Logistics

Sponsored Session

Chair: Michael Ball, Professor, University of Maryland, Robert H Smith School of Business, College Park, MD, 20742, United States of America, mball@rhsmith.umd.edu

1 - Hybrid Communication and Control Algorithms for Managing Aircraft Arrivals
Hamsa Balakrishnan, Massachusetts Institute of Technology, 77 Massachusetts Ave., 33-328, Cambridge, MA, 02139, United States of America, hamsa@mit.edu, Pangun Park, Harshad Khadilkar, Claire Tomlin

New air traffic surveillance technologies such as ADS-B enable more distributed trajectory management, but also raise concerns of interactions with legacy infrastructure. We present an algorithm to manage aircraft arrivals that combines centralized control in congested areas with distributed control in less dense ones. This hybrid approach is evaluated through simulations. Its performance is found to be comparable to fully centralized strategies, despite requiring less ground infrastructure.

2 - Improved Required Time of Arrival Functionality in the Presence of Uncertainty
John-Paul Clarke, Associate Professor, Georgia Tech, 270 Ferst Drive N.W., Atlanta, GA, 30332-0150, United States of America, johnpaul@gatech.edu, Clayton Tino

Required Time of Arrival (RTA) functionality must be improved to enable Trajectory-Based Operations (TBO) as proposed for the Next Generation Air Transportation System (NextGen). We address this need by developing a heuristic algorithm that computes the best cruise speed given modeled uncertainties in the en route winds and the potential actions that could be taken further along the trajectory to ensure to a given probability that the RTA is met while minimizing the fuel that is expended.

3 - Cost-based Cruise Linear Holding with Delay Recovery for ATFM
Luis Delgado, Assistant Professor, Technical University of Catalonia, Esteve Terradas, 5, Room C3-120 PMT, Castelldefels, 08860, Spain, luis.delgado@upc.edu, Xavier Prats

Cruise speed reduction can be used to absorb delay during the flight, in what can be considered a linear holding. With this strategy, it is possible to divide assigned delay between ground and air without incurring extra fuel consumption, with respect to the airline's initial flight plan. With the suggested strategy, if the regulation is cancelled while a plane is airborne, part of this delay can be recovered.

4 - En Route Speed Control Methods for Transferring Terminal Delay
James Jones, University of Maryland, College Park, MD, 20742, United States of America, jonesjc1@umd.edu, David Lovell, Michael Ball

We present an approach for transferring terminal delay to the en route phase of flight. We propose a multi-objective integer programming model designed to assign delays to flights in advance of the terminal. The model weights an objective of fuel savings and throughput to assign controlled times of arrival to flights 500 nmi from the airport. We demonstrate that the model can effectively transfer delay en route. This delay transfer yields significant fuel savings benefits on a per flight basis.

■ MD71

Mezzanine -101B

Aviation Delay Modelling and Impact Assessment

Sponsor: Aviation Applications

Sponsored Session

Chair: Cheng-Lung Wu, Senior Lecturer, University of New South Wales, R218, Old Main Building, School of Aviation, Kensington, NSW, 2052, Australia, c.l.wu@unsw.edu.au

1 - Two Ways of Estimating the Delay Impact of New York Airports
Lu Hao, University of California,Berkeley, Berkeley, CA, United States of America, haolu@berkeley.edu, Mark Hansen, Yu Zhang, Joseph Post

Two different approaches are taken to quantify the impact of the three New York airports on delay throughout the NAS. First we apply an econometric model using a large historical dataset. The other model is the FAA SWAC model that simulates flights and tracks the daily system performance. The counterfactual scenarios in these two models are adjusted to be comparable. Both results conclude that the portion of delay in the system caused by New York airports is much less than publicized estimates.

2 - Mixed Set Programming for Integrated Recovery of Aircraft and Crew
Jinfu Zhu, Professor, Nanjing University of Aeronautics and Astronautics, No.29 Yudao Road, Nanjing, JS, 211100, China, zhujf@nuaa.edu.cn, Bo Zhu

Constraint programming model for integrated schedule recovery of aircraft and crew was built. The searching algorithm was designed by using mixed set programming. Calculation result indicates that for medium and large scale examples, the delay obtained by the proposed method reduces by 24.69% compared with the sequential recovery method. By using sequential method, 22.2% examples cannot obtain feasible solution, which shows the feasibility and superority of integrated recovery method.

3 - Analysis of Flight Operation Reliability based on the Correction Delay Propagation Tree
Weiwei Wu, Nanjing University of Aeronautics and Astronautics, 29, Yudao Street, Baixia District, Nanjing, China, nhwei@nuaa.edu.cn, Cheng-Lung Wu

We make a probability analysis of airport's flight delay factors based on Bayesian Network to modify the flight delay propagation tree.A set of measuring indices is developed to evaluate schedule reliability and economy.This model can evaluate the influence of airports,airlines and passengers on flight delay.Two flight schedules from an Chinese airline are compared and shows that this modified delay propagation tree is feasible and has practical value.

4 - Impacts of Flight Cancellations on Delay Forecasting
Michael Seelhorst, University of California, Berkeley, 1710 Delaware St., Berkeley, CA, 94703, United States of America, mseelhorst@berkeley.edu, Mark Hansen

Flight cancellations are often the result of a complex decision process. Using historical flight information, we can infer the factors important by airlines in making these decisions. Using a deterministic queueing framework, we can then extend the investigation to the impact of cancellations on airline performance. In particular, we investigate flight delays. We find that delay forecasting measures can be off by 5-10% if cancellations are not accounted for.

■ MD72

Mezzanine -101C

Time Consistent Control in Portfolio Selection/Risk Management

Cluster: Risk Management

Invited Session

Chair: Duan Li, Patrick Huen Wing Ming Professor of SEEM, The Chinese University of Hong Kong, Dept. of Sys. Eng. & Eng. Manag., Shatin, NT, Hong Kong - PRC, dli@se.cuhk.edu.hk

1 - Numerical Solution of the HJB Formulation for Continuous Time Mean Variance Asset Allocation
Peter Forsyth, Professor, University of Waterloo, Cheriton School of Computer Science, Waterloo, Canada, paforsyt@uwaterloo.ca

We solve the optimal asset allocation problem using a mean variance approach, by solving an equivalent formulation in terms of solution of a Hamilton Jacobi Bellman (HJB) Partial Differential Equation (PDE). We use a finite difference method with fully implicit timestepping to solve the resulting non-linear HJB PDE. We include numerical results comparing time inconsistent and time consistent mean variance strategies, as well as mean quadratic variation policies.

2 - Overcoming Time Inconsistency in Efficiency by Relaxing Self-Financing Restriction
Xiangyu Cui, Professor, Shanghai University of Finance and Economics, School of Statistics and Management, Shanghai, China, cui.xiangyu@mail.shufe.edu.cn, Duan Li

The dynamic mean-variance model for markets with all risky assets is not time consistent in efficiency, i.e., the pre-committed policy, which is optimal for the entire investment horizon, could become inefficient when considering a truncated time-horizon problem. By relaxing self-finance restriction and allowing to invest only part of current wealth in the market, we develop a revised dynamic mean-variance policy and compare it with the pre-committed policy and the time consistent policy.

3 - Time Consistency in Efficiency for Discrete-time Cone Constrained Markets
Duan Li, Patrick Huen Wing Ming Professor of SEEM, The Chinese University of Hong Kong, Dept. of Sys. Eng. & Eng. Manag., Shatin, NT, Hong Kong - PRC, dli@se.cuhk.edu.hk, Xiangyu Cui

We derive the semi-analytical expressions of the global (pre-committed) efficient mean-variance policy for convex cone constrained markets and investigate analytically effects of portfolio constraints on time consistency in efficiency (TCIE), which further enables us to establish a general solution framework in constructing TCIE dynamic portfolio selection problem formulations by introducing suitable portfolio constraints.

Tuesday, 8:00am - 9:30am

■ TA01

Level 2 - Room 200A

Optimal Execution and Market Microstructure

Cluster: Optimization in Finance

Invited Session

Chair: Gerry Tsoukalas, University of Pennsylvania, Wharton School, Philadelphia, PA, United States of America, gtsouk@wharton.upenn.edu

Co-Chair: Ciamac Moallemi, Associate Professor, Columbia University, 3022 Broadway Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

1 - Information and the Value of Execution Guarantees
Krishnamurthy Iyer, Cornell University, 204 Rhodes Hall, Ithaca, NY, 14853, United States of America, ki82@cornell.edu, Ramesh Johari, Ciamac Moallemi

We assess the role of information in the choice between certain trade at a price premium in an intermediated dealer market and contingent trade in a dark pool. Our setting consists of traders with heterogeneous private information as to an asset's value, who endogenously decide between the two venues. We analyze how this choice depends on the information available to an individual agent as well as on the distribution of information across all agents, and study the effect of dark pool on welfare.

2 - A Multiclass Queueing Model of Limit Order Book Dynamics
Hua Zheng, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, hzheng14@gsb.columbia.edu, Costis Maglaras, Ciamac Moallemi

We formulate and solve a problem of limit and market order placement in a limit order book to optimally buy a block of shares over a short, predetermined time horizon. We use the structure of the optimal execution policy to propose a microstructure model of market impact, which we estimate using trade data and highlight its increased accuracy over "macro" market impact models.

3 - Optimal Trade Execution with Coherent Dynamic Risk Measures
Qihang Lin, PhD Student, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, qihangl@andrew.cmu.edu, Javier Pena

We study the problem of optimal trade execution in an illiquid market by minimizing the coherent dynamic risk of the implementation shortfall. The prices of the assets are modeled as a Markov process perturbed by the impacts related to the trading volume. A closed-form optimal strategy is obtained for liquidating a single asset. In the case of multiple assets, we show that the optimal execution strategy can be solved by efficiently first-order methods.

■ TA02

Level 2 - Room 200B

Emerging Applications of Large-Scale Nonlinear Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Victor Zavala, Assistant Computational Mathematician, Argonne National Laboratory, 9700 S Cass Ave., Lemont, Il, 60439, United States of America, vzavala@mcs.anl.gov

1 - Robust Planning Optimization for Intensity Modulated Proton Therapy
Behlul Saka, Research Scientist, Elekta, 13723 Riverport Dr., Suite 100, Maryland Heights, United States of America, Behlul.Saka@elekta.com, Chunhua Men

Intensity Modulated Proton Therapy (IMPT) provides more degrees of freedom for designing dose distributions than photon IMRT. However, IMPT distributions are much more sensitive to uncertainties in radiologic path length and set-up errors. To mitigate the effects of these uncertainties, non-linear robust optimization models ranging from expected value optimization to worst-case optimization are developed. We present our results by testing the proposed models on patient cases.

2 - Scalable Strategies for Stochastic Network Problems
Nai-Yuan Chiang, Argonne National Laboratory, 9700 S. Cass Avenue, Lemont, IL, 60439, United States of America, nychiang@mcs.anl.gov

The aim of this research is to demonstrate some more efficient approaches to solve the n-1 AC-SCOPF problems by using structure-exploiting primal-dual interior point methods. A new contingency generation algorithm is presented, which starts with solving the basic OPF problem and then generates contingency scenarios dynamically during the solution process. Additionally, we also apply graph partitioning techniques to analyze the network behaviour and to decompose the network.

3 - NLP Approaches for Estimation of Seasonal Transmission Parameters in Childhood Infectious Diseases
Carl Laird, Professor, Texas A&M University, 3122 TAMU, College Station, TX, 77843, United States of America, Carl.Laird@tamu.edu, Daniel Word, Derek A.T. Cummings

Childhood infectious diseases remain a serious public health issue. Efficient estimation techniques are required to understand temporal dynamics and develop effective control strategies. In this work, we use nonlinear interior-point methods to estimate seasonal parameters in infectious disease models using measles case count data. Our results show seasonal patterns that are strongly correlated with school term holidays across very different social settings and holiday schedules.

4 - Use of Complementarity Constraints to Solve Partially Discrete OPF-MPEC Problems
Pierre Girardeau, Artelys, 12, Rue du 4 Septembre, Paris, France, pierre.girardeau@artelys.com, Manuel Ruiz, Arnaud Renaud, Jean Maeght, Sylvain Mouret

We present numerical optimization methodologies to solve partially discrete Optimal Power Flow (OPF) problems on a large scale. This work is done jointly with the French TSO, RTE, within the iTesla project. Our objective in iTesla is two-fold: efficiently deal with integer variables using MPEC formulations and treat large-scale problems (several thousands of buses). Using AMPL and KNITRO, we show how these objectives have been reached, both on academic/IEEE and on real-life instances.

■ TA03

Level 2 - Room 200C

Recent Advances in Global Optimization I

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Evrim Dalkiran, Assistant Professor, Wayne State University, 4815 4th St., Manuf. Eng. Bldg. #2173, Detroit, MI, 48202, United States of America, evrimd@wayne.edu

1 - Global Optimization of Problems with Edge-concave Intermediates
Yash Puranik, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ypp@andrew.cmu.edu, Aida Khajavirad, Nick Sahinidis

We describe a branch-and-cut implementation that relies on a highly efficient solution of linear separation problems for obtaining facet defining cuts for edge-concave functions. Standard test libraries are used to demonstrate the effectiveness of the proposed approach.

2 - Convexification Techniques for Separable Polynomial Inequalities
Mohit Tawarmalani, Professor, Purdue University, 100 S Grant Street, Room 4019, West Lafayette, IN, 47907, United States of America, mtawarma@purdue.edu, Jean-Philippe Richard

In this paper, we develop techniques for convexifying separable polynomial covering inequalities over a hypercube using disjunctive arguments. We discuss various decomposition strategies for creating convex hulls. Then, we provide various linear and nonlinear valid inequalities in an explicit form. We discuss separation procedures for deriving other valid inequalities. Finally, we extend our results to quasi-convex knapsacks and to reverse convex constraints.

3 - RLT-POS: Reformulation-Linearization Technique-based Optimization Software for Polynomial Programs
Evrim Dalkiran, Assistant Professor, Wayne State University, 4815 4th St., Manuf. Eng. Bldg. #2173, Detroit, MI, 48202, United States of America, evrimd@wayne.edu, Hanif D. Sherali

We introduce a Reformulation-Linearization Technique-based open-source optimization software for solving polynomial programs (RLT-POS). We present algorithms that form the backbone of RLT-POS, including constraint filtering techniques, reduced RLT representations, semidefinite cuts, and bound-grid-factor constraints. We present computational results to demonstrate the improvement over standard RLT, and compare the performances of the software packages BARON, SparsePOP, and Couenne with RLT-POS.

■ TA04

Level 2 - Room 200D

Stochastic Mixed-Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Minjiao Zhang, The Ohio State University, 210 Baker Systems Building, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, zhang.769@osu.edu

1 - On the Mixing Set with a Knapsack Constraint

Ricardo Fukasawa, Associate Professor, University of Waterloo, 200 University Avenue West, Waterloo, N2L3G1, Canada, rfukasaw@math.uwaterloo.ca, Ahmad Abdi

We study the mixing set with a knapsack constraint, a substructure that appears when using integer programming reformulations for chance-constrained linear programs with random right-hand-sides. We show that any polyhedral knowledge of the knapsack set can be translated into polyhedral knowledge of the given set. We also comment on issues that arise when using our results to separate valid inequalities via linear programming and propose solutions for them.

2 - A Generalized Benders' Algorithm for the Two-stage Stochastic Mixed Integer Linear Problem

Anahita Hassanzadeh, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, anh509@lehigh.edu, Ted Ralphs, Menal Güzelsoy

One difficulty in generalizing the traditional Benders' scheme to general two-stage mixed integer linear stochastic problems arises in the challenge of finding effective functions to approximate the value function of the second stage problem from below. We focus on dual functions derived from branch-and-bound trees arising from solution of recourse subproblems. We elaborate on both the theoretical and computational implications of solving the two-stage problem with such dual functions.

3 - Partition-based Algorithms for Solving Two-stage Stochastic Programs

Yongjia Song, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, ysong29@wisc.edu, James Luedtke

We studied partition-based algorithms for solving two-stage stochastic linear programs. The basic idea is to iteratively solve a smaller problem with scenarios aggregated according to a specific partition, and refine the partition based on the obtained relaxation solution value. Computational results indicates that this approach is particularly effective when the scenario size is large.

4 - Finitely Convergent Decomposition Algorithms for Two-Stage Stochastic Pure Integer Programs

Minjiao Zhang, The Ohio State University, 210 Baker Systems Building, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, zhang.769@osu.edu, Simge Küçükyavuz

We study a class of two-stage stochastic pure integer programs with general integer variables in both stages and finitely many realizations of the uncertain data. Based on Benders' method, we propose decomposition algorithms with parametric Gomory cuts, and prove their finite convergence. We demonstrate our algorithms by examples, and present preliminary computational results.

■ TA05

Level 2 - Room 200E

Integer Programming and Networks

Sponsor: Optimization/Networks

Sponsored Session

Chair: Kelly Sullivan, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ksulliv@uark.edu

1 - A Branch-and-Price-and-Cut Approach for Maximum Multiple Weighted Clique Problem

Seyed Javad Sajjadi, University of South Florida, 4202 E Fowler Ave., ENC 2400, Tampa, FL, 33620, United States of America, ssajjadi@mail.usf.edu, Bo Zeng, Xiaoning Qian

We consider deriving a collection of cliques with the maximum weight in a general network where both nodes and arcs are weighted, which can be potentially applied for the biomarker identification problem in bioinformatics. An algorithm integrating column generation, branch-and-bound and cutting plane methods is developed for efficient computing. We also present numerical results based on random networks and biological networks with real data.

2 - Robust Network Interdiction with Invisible Interdiction Assets

N. Orkun Baycik, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, nobaycik@email.uark.edu, Kelly Sullivan

In the shortest path network interdiction problem, a leader seeks to maximize the length of a follower's path through the network by interdicting (or lengthening) arcs. Most studies of this problem are based on the assumption that the leader's actions are visible to the follower. We seek to find a placement of invisible interdictions robust against the possibility that some of the interdictions may become visible. We present a solution approach for this problem and a brief computational study.

3 - An Algorithm for Multi-level Network-design Models Arising in Evacuation Problems

Yen Tang, Ph.D Candidate, University of Florida, Gainesville, FL, 32611, United States of America, yentang@ufl.edu, Jean-Philippe Richard, J. Cole Smith

We study the problem of constructing arcs in a network to minimize the cost needed to evacuate a population in the face of disaster, assuming that "nature" is an intelligent agent. We consider four variants where the disaster is/is not restricted to fixed locations, or when the number of evacuated people either does or does not depend on the disaster's location. We formulate a three-level programming for this problem, along with a finitely convergent algorithm for their solution.

4 - Designing Networks with Transit Time Constraints

Sifeng Lin, University of Texas at Austin, 1 University Station, Austin, TX, 78712, United States of America, sifenglin@utexas.edu, Prakash Mirchandani, Anant Balakrishnan

We address a multi-commodity fixed-charge network design problem with upper limits on the total transit time (or length) of each commodity's origin-to-destination path. We consider alternative model formulations, propose valid inequalities to strengthen the models, outline problem reduction strategies, and discuss decomposition solution methods. Our computational results for a variety of test problems demonstrate the efficacy of the modeling enhancements and solution approach.

■ TA06

Level 2 - Room 200F

Network Optimization II

Sponsor: Optimization/Networks

Sponsored Session

Chair: Michael Padilla, Assistant Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, michael_padilla@sutd.edu.sg

1 - The TSP Race Problem: How to Minimize Completion Time in Real Time TSP Applications

Bahar Cavdar, Georgia Institute of Technology, 755 Ferst Drive, NW, Main Building, Office: 447, Atlanta, Ge, 30332, United States of America, baharca@gatech.edu, Joel Sokol

In real time Traveling Salesman Problem applications, the computation time is as important as implementation time. However, the current literature focuses on minimizing the travel time and deals with the computational complexity as a secondary criterion. We study TSP Race problem by redefining the objective of the TSP as minimizing the total time from getting the instance to finishing the tour and focus on the computation-implementation time tradeoff.

2 - Acceleration Strategies for the Weight Constrained Shortest Path Problem with Replenishment

Andrés L. Medaglia, Associate Professor, Universidad de los Andes, Departamento de Ingeniería Industrial, COPA, Bogota, Colombia, amedagli@uniandes.edu.co, Leonardo Lozano, Manuel Bolivar

The Weight Constrained Shortest Path Problem with Replenishment (WCSPP-R) generalizes the Constrained Shortest Path Problem (CSP). We present an exact algorithm that extends the ideas proposed in the state-of-the-art algorithms for the CSP and WCSPP-R. The novelty relies in a set of acceleration strategies that significantly improves the algorithm performance. We conducted experiments over large real-road networks achieving considerable speedups against the state-of the-art algorithm.

3 - The Micks: Strong Knapsack Facets

Sangho Shim, Research Associate, Kellogg School of Management/Northwestern University, 2001 Sheridan Road Suite 548, Evanston, IL, 60208, United States of America, shim@northwestern.edu, Wenwei Cao, Sunil Chopra

We perform the worst case analysis of the knapsack facets and identify the strongest knapsack facets which we call the Micks. We develop a linear time separation algorithm to identify the most violated Micks.

4 - A Column Generation Algorithm for the Cross-layer Survivable Network Design

Tachun Lin, Assistant Professor, Cameron University, 2800 W Gore Blvd, Lawton, OK, 73505, United States of America, tlin@cameron.edu, Zhili Zhou

We present a mixed-integer programming model and a column generation algorithm for the cross-layer survivable routing problem. The proposed model requires less number of constraints and variables, where the number is similar to those used in the regular network routing problem. The pricing problem in one of the sub-problems of the proposed column generation algorithm is still exponential, but the computational results demonstrate the efficiency of the column generation algorithm.

■ TA07

Level 2 - Room 200G

Stochastic Programming Approaches to Service System Staffing and Scheduling Problems

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Merve Bodur, University of Wisconsin-Madison, 1513 University Ave., Madison, WI, 53706, United States of America, mbodur@wisc.edu

1 - Forecasting and Staffing Call Centers with Multiple Uncertain Arrival Streams

Haipeng Shen, University of North Carolina-Chapel Hill, Chapel Hill, NC, United States of America, haipeng@email.unc.edu, James Luedtke, Haipeng Shen

We study the integrated problem of forecasting and staffing call centers with multiple uncertain arrival streams. We develop models to forecast multi-stream call arrivals, by considering three types of Inter-Stream Dependence (ISD). With the forecasts, we use a chance-constraint formulation to generate staffing vectors and further assess the operational effects. Our theoretical and numerical analyses bring insights into how various types of ISD affect forecasting and operational practice.

2 - Integrated Staffing and Scheduling for Service Systems via Stochastic Integer Programming

Merve Bodur, University of Wisconsin-Madison, 1513 University Ave., Madison, WI, 53706, United States of America, mbodur@wisc.edu, James Luedtke

We consider the joint problem of staffing (determining how many servers of each type should be available in each time period) and scheduling (assigning servers to feasible schedules) in a service system having multiple server types and multiple customer classes. We introduce a stochastic integer programming formulation and study solution methods for this problem class.

3 - Strategies for Solving Stochastic Call Center Scheduling Models using Excel

Thomas Robbins, Assistant Professor, East Carolina University, 3212 Bate Building, Greenville, NC, 27858, United States of America, robbinst@ecu.edu

Call center scheduling models are in general quite computationally intensive. Stochastic programming formulations are even more intensive. In this talk we examine the feasibility of solving these models in what is often the supervisor's tool of choice– Excel. We present a number of strategies for achieving quality results within the constraints of the Excel environment.

4 - Improving Quality of Service and Fairness in Stochastic Operating Room Planning

Yan Deng, University of Michigan, Ann Arbor, MI, United States of America, yandeng@umich.edu, Brian Denton, Siqian Shen

Existing research on stochastic operating room planning rely on cost-based formulation that weighs metrics and fails in modeling quality of service or fairness. We introduce a chance-constrained programming formulation that overcomes the drawback. For both formulations, we explore an approach of solving time-indexed reformulation using column generation. We test them on instances generated from real data to compare computational efficacy and draw managerial insights.

■ TA08

Level 2 - Room 200H

Modeling Tools for Economic Equilibrium Analysis

Sponsor: Computing Society

Sponsored Session

Chair: Thomas Rutherford, Professor, University of Wisconsin Madison, AAE Department, 427 Lorch Street, Madison, WI, 54706, United States of America, rutherford@aae.wisc.edu

1 - Extended Mathematical Programming and Competitive Equilibrium

Michael Ferris, Professor, University of Wisconsin, Computer Sciences Department, Madison, WI, United States of America, ferris@cs.wisc.edu, Jesse Holzer

We present a mechanism for describing and solving collections of optimization problems that are linked by equilibrium conditions. The general framework captures many example applications that involve independent decisions coupled by shared resources. We describe this mechanism in the context of energy planning and environmental and land-use problems We outline several algorithms and investigate their computational efficiency.

2 - Second Order Sensitivity in Applied General Equilibrium

Florian Landis, ZEW Mannheim, L7, 1, Mannheim, 68161, Germany, landis@zew.de

In applications of general equilibrium modeling, the functional form of cost functions is often chosen based on suitability for numerical solution of the model and calibrated to benchmark data. Assuming weak empirical foundation for this choice, it is a priori unclear to what extent results are driven by it. I present a method for performing second-order sensitivity analysis with respect to functional form, apply it to three general equilibrium models from the literature, and discuss results.

3 - GAMS/MPSGE Version 2

Thomas Rutherford, Professor, University of Wisconsin Madison, AAE Department, 427 Lorch Street, Madison, WI, 54706, United States of America, rutherford@aae.wisc.edu

While algebraic modeling languages are helpful, the precise representation of multisectoral models is tedious and error prone. GAMS/MPSGE provides a tabular, non-algebraic modeling format which automates calibration and reduces the scope for errors in model specification. A new open source implementation of MPSGE, written in GAMS, accommodates optimal taxation, embedded gams-theoretic models and models with growth, infrastructure or pollution externalities.

■ TA09

Level 2 - Room 200I

Quantitative Methods in Analytics

Sponsor: Analytics Section

Sponsored Session

Chair: Flora Spieksma, Leiden University, Niels Bohrweg 2, Leiden, Netherlands, spieksma@math.leidenUniversitynl

Co-Chair: Michael Katehakis, Professor and Chair, Rutgers University, MSIS Department, 94 Rockafeller Road, Piscataway, NJ, 08854, United States of America, mnk@rutgers.edu

1 - Explicit Solutions and Other Properties of Successively Lumpable Quasi Skip Free Processes

Laurens Smit, Rutgers University and Leiden University, 1 Washington Park, Newark, NJ, United States of America, lcs116@pegasus.rutgers.edu, Flora Spieksma, Michael Katehakis

We consider the class of Quasi-skip-free processes (QSF), a generalization of the quasi-birth-and-death processes. We use a simple condition under which a QSF is successively lumpable (SL-QSF) and the steady state distribution can be calculated explicitly and rapidly. We use this property to derive explicit solutions for the steady state probabilities of queueing models as the priority queue and the longest queue model. We discuss the benefits of using successive lumping over existing methods.

2 - Sufficiency of Markov Policies in Continuous-time Markov Decision Processes

Manasa Mandava, Stony Brook University, Department of Applied Mathematics, Stony Brook, NY, United States of America, manasamandava@gmail.com, Eugene Feinberg, Albert Shiryaev

One of the basic facts in the theory of Discrete-Time Markov Decision Processes is that for any policy there exists a randomized Markov policy with the same marginal state-action distributions. This fact implies that for expected total (discounted) costs and average costs per unit time, it is sufficient to restrict the set of all policies to the set of randomized Markov policies. In this talk we present similar results for Continuous-Time Markov Decision Processes (CTMDPs).

3 - Inventory Optimization for a Product with Random Defects

Jim Shi, Assistant Professor, Georgia State University, 35 Broad Street, Altanta, GA, 30303, United States of America, shigsu@gmail.com

This paper studies single-period and multiple-period inventory optimization of a single product with random defects. The amount of available inventory to satisfy demand is randomly proportional to the total amount of inventory after ordering. We apply dynamic programming to derive and characterize the optimal ordering quantity.

4 - The Multi-armed Bandit Problem with Commitments: Generalized Depreciation and Necessity of Restart Indices

Wesley Cowan, Rutgers University, Dept. of Mathematics, 110 Frelinghuysen Rd., Piscataway, NJ, 08854, United States of America, cwcowan@math.rutgers.edu, Michael Katehakis

The multi-armed bandit problem is one of the most basic models for sequential decision problems with exploration–exploitation trade-offs. It has applications from clinical trials to data mining and machine learning. In this talk we present a new, nice proof for the celebrated Gittins index decomposition. We also present several extensions to the theory that are made possible with our approach.

5 - Monotonicity of Thresholds and Switching Curves in Queueing Control

Flora Spieksma, Leiden University, Niels Bohrweg 2, Leiden, Netherlands, spieksma@math.leidenUniversitynl

Optimality of threshold policies in arrival control of single server queues is often proved through the successive approximations algorithm for Markov Decision Processes. Interestingly enough, the same algorithm can be used to show monotonicity of the threshold as a function of the iteration step. This allows to obtain bounds for the optimal threshold. Similar phenomena occur in two-dimensional optimal control models where a switching curve, instead of an index policy, is optimal. We discuss various examples.

■ TA10

Level 2 - Room 200J

Outsourcing and/or Offshoring Analytics

Sponsor: CPMS, The Practice Section

Sponsored Session

Chair: Peter Bell, Professor, Western University, Ivey School of Business, London, ON, N6A3K7, Canada, pbell@ivey.uwo.ca

1 - Panel: Outsourcing and/or Offshoring Analytics

Moderator: Peter Bell, Professor, Western University, Ivey School of Business, London, ON, N6A3K7, Canada, pbell@ivey.uwo.ca

More and more companies are now buying their analytics from domestic or offshore suppliers. Others operate 'captive' offshore analytics divisions. This panel will discuss the benefits and costs of these analytics acquisition strategies as well as the reasons for the dramatic growth in analytics outsourcing/offshoring.

■ TA11

Level 2 - Room 201A

Adherence and Decrement, The Keys to Managing Chronic Disease

Sponsor: Minority Issues

Sponsored Session

Chair: Sean Brooks, Chair Mathematics and Computer Sc, Coppin State University, 2500 W. North Ave., Baltimore, MD, 21216, United States of America, sbrooks@coppin.edu

1 - Adherence and Decrement the Keys to Managing Chronic Disease; The Health Belief Model (HBM) and Managing Chronic Disease

Joan Tilghman, Professor of Nursing, Coppin State University, College of Health Professions, 2500 West North Avenue, Baltimore, MD, United States of America, JTilghman@coppin.edu

This session will focus on the Health Belief Model as a predictor of health behaviors of individuals. The Health Belief Model is a model utilized in health care to attempt to explain and predict health behaviors (Glanz, K., Marcus Lewis, F. & Rimer, B.K. (1997), The Health Belief Model can used as a predictor. However the variables that influence an individual's decisions about health care are based on focusing on the attitudes and beliefs of individuals. There are times when calculations based on mathematical models to anticipate and predict chronic diseases can be inaccurate. The outcomes of individual attitudes and beliefs about managing chronic disease frequently cannot be mathematically derived with accuracy. This session will discuss utilization of the Health Belief Model as an indicator for the management of chronic diseases. The session will include a discussion about high fidelity simulation and how that technology promotes advancements in information sharing and can be a viable adjunct to identify and promote optimal health outcomes. Thus simulation utilization can aid in the management of chronic disease. The objectives for this session include: a. Understanding the concepts and application of the HBM in managing chronic diseases. b. Identification of the influence of HBM as it relates to attitudes and beliefs on individual health care decisions. c. Utilization of the HBM to explain and predict adherence to managing as a component of managing chronic disease. d. Identification of the utility of use of high fidelity simulation to aid in the management of chronic disease(s).

2 - Geo-mapping: Adherence Health Information Models and Management of Chronic Disease with GIS as an Individual and Community Concern

Rashid Malik, GIS/Health Informatics/Database Manager, Maryland Department of Health and Mental Hygiene, 201 W. Preston Street, Baltimore, MD, 21201, United States of America, rashid.malik@maryland.gov, James C. Thomas

Maryland Department of Health and Mental Hygiene (DHMH) has built a robust GIS infrastructure to dynamically present an array of health information on the internet to Maryland communities. Such presentation can be used to easily identify trends to reduce mortality and morbidity, improve access to care, and improve health outcomes. Maryland DHMH's adoption of geo-mapping has served as an effective gateway to increase agility and more accurate and complete health data has been made available to communities. Geo-mapping has been effective in communicating essential public health information with communities at risk in simpler terms, which otherwise can be complex data to interpret and analyze.

3 - Adherence and Decrement Keys to Managing Chronic Disease

Sean Brooks, Chair Mathematics and Computer Sc, Coppin State University, 2500 W. North Ave., Baltimore, MD, 21216, United States of America, sbrooks@coppin.edu

An important first step in developing mathematical models that accurately describe the Management of Chronic Disease understands Adherence and Decrement. Here we explore the relationship between the mathematical definition of adherence and health adherence in managing chronic disease. Further, the relationship between adherence and decrement is explored mathematically. Decrement for us or departure from adherence occurs due to death during adherence and disease transition. We propose a method of capturing disease transition in the context of decrement. The utilization of high fidelity simulation can assist in exploring the relationship between adherence and disease transition Finally, we ask in what sense our analysis could produce cost effective management strategies.

■ TA12

Level 2 - Room 201B

SpORts - Networks

Sponsor: SpORts

Sponsored Session

Chair: Kevin Hutson, Furman University, Greenville, SC, United States of America, kevin.hutson@furman.edu

1 - Predicting Head-to-Head Matches with Multiple Variables for NCAA Basketball

Tyler Perini, College of Charleston, 175 Calhoun St-RSS 339, Charleston, SC, 29401, United States of America, perinita@g.cofc.edu, Amy Langville

While the typical American cheers for a team as the result of one's own heritage or tradition, these matches, to mathematicians, are complex, dynamic, and deeply organic systems. With Massey Rankings, and developing new variations of this method, we can make predictions based solely on the premise of a team's past score differentials. In reality, however, sports teams' successes are a culmination of style of play, momentum, rivalry, home advantage, and countless other 'human' factors. Only some of these numerous factors can be quantified and analyzed, but consolidating them into a single quantity can limit many of the accessible trends in the data. This work addresses strategies used in targeting some of these factors and maintaining them as unique and independent strata of data to compare NCAA basketball teams and to predict the winners of season matches. Using some select statistics, analyzing both the offensive and defensive style of each team, we developed a search-engine-like method to identify a team's neighborhood of other teams most similar in style of play; then, when analyzing a match-up between teams, we look at the opponents' pools of similar teams and their collective histories to predict the winner of the face-offs. Combined with the ranking methods, we included other factors into a linear regressionóin this way, we redefined 'victory' as the resultant of many influences, aiming to more realistically model and predict sports matches, and slightly increased the accuracy of head-to-head match predictions.

2 - A Simple Network Approach to Ranking Athletic Teams

Douglas Shier, Clemson University, Mathematical Sciences, Clemson, SC, 29634, United States of America, shierd@clemson.edu, Andrew Lee

We present a method used to rank sports teams utilizing pairwise win-loss comparisons. These pairwise comparisons are represented by a directed network, with nodes representing teams and edge weights defined appropriately. Rankings are obtained by a simple approach: based on the weights of simple paths in the network. Results are presented for several NCAA football seasons and are compared with rankings produced by other established ranking systems.

3 - On the Carry-over Effect

Dries Goossens, Ghent University, Belgium, Dries.Goossens@kuleuven.be

Any schedule for a round robin tournament involves an order in which each team (or player) meets its opponents. If some team X plays against team A and subsequently against team B, we say that team B receives a carry-over effect to team A. Indeed, it is conceivable that team A affects team B's result against X through e.g. fatigue, injury, or morale. We discuss how these effects can be balanced, and to what extent they have a real influence in soccer and tennis.

4 - Finding the Most Important Edges in a Network

Kevin Hutson, Furman University, Greenville, SC, United States of America, kevin.hutson@furman.edu, Michael Berry, Tim Chartier, Amy Langville

As teams play during a season a network encoding wins and losses of teams can be constructed. There are several ranking methods that can be used on this win-loss network to produce a ranking of teams. In this talk, we present several methods to determine which edges (games) in the network have the most influence in determining such a ranking order of the teams. We apply these methods to college football to determine the most important, or influential, games in that season.

■ TA13

Level 2 - Room 202A

Innovation and New Product Development in Emerging Contexts

Cluster: New Product Development

Invited Session

Chair: Anant Mishra, Professor, George Mason University, Fairfax, VA, United States of America, amishra6@gmu.edu

1 - Protecting the Confidentiality of Shared Information: The Effects of Location

Brett Massimino, The Ohio State University, 418 Hemhill Drive, Columbus, OH, 43119, United States of America, massimino.3@osu.edu, John Gray, Ken Boyer

We examine the effects of location-related factors on the confidentiality of product-level information in a distributed product development context. We introduce a novel measure of information confidentiality, and account for client, vendor, dyadic, and product characteristics in our analyses. Unique data is obtained through the web-crawling of underground, black-market distribution servers in the video game industry.

2 - Product Reuse in Industries with Radical Innovations

Vedat Verter, Prof, Desautels Faculty of Management, McGill University, 1001 Sherbrooke West, Montreal, H3A 1G5, Canada, vedat.verter@mcgill.ca, Mathijn Retel Helmrich, Tamer Boyaci

We study how a firm's decision of whether or not to reuse products is influenced by innovations taking place in the industry, especially when these innovations are not only incremental in nature, but there is also a chance that a radical innovation will take place, thereby changing consumer's valuations of reused products, which do not contain this radical innovation. A Markov decision process is used to model the firm's various decisions.

3 - Control, Capability and Cost in Outsourcing

Cheryl Druehl, George Mason University, 4400 University Drive, Fairfax, United States of America, cdruehl@gmu.edu, Gal Raz

We study the impact of control (decision rights on design/process innovation effort), capability (who is better at innovation), and innovation cost on outcomes. We consider outsourcing manufacturing/process innovation or outsourcing design/process innovation/manufacturing. With wholesale price contracts, the buyer never outsources both design/manufacturing. With a two-part tariff, the buyer outsources both design/manufacturing if the supplier is better in one factor and equal in the other two.

■ TA14

Level 2 - Room 202B

Journal of Systems Science and Systems Engineering

Cluster: International Activities Committee

Invited Session

Chair: Guoqing Zhang, Professor, University of Windsor, 401 Sunset Avenue, Windsor, Canada, gzhang@uwindsor.ca

Co-Chair: Jian Chen, Professor, Tsinghua University, Beijing, China, jchen@mail.tsinghua.edu.cn

1 - An Overview about Journal of Systems Science and Systems Engineering

Jian Chen, Professor, Tsinghua University, Beijing, China, jchen@mail.tsinghua.edu.cn

During this presentation, the editor of JSSSE will give an overview of the Journal. He will give some facts about the journal, explain the review process, and point out the topics. Some general questions will be welcome after the presentation.

2 - Coordinating Production and Recycling Decisions with Stochastic Demand and Return

Guoqing Zhang, Professor, University of Windsor, 401 Sunset Avenue, Windsor, Canada, gzhang@uwindsor.ca, Jichang Sha, Saman Hassanzad Amin, Jianmai Shi

In this paper, the joint production and recycling problem is investigated for a hybrid manufacturing and remanufacturing system where brand-new products are produced in the manufacturing plant and recycled products are remanufactured into as-new products in the remanufacturing facility.

3 - Many-server Queues with Customer Abandonment: A Survey of Diffusion and Fluid Approximations
Jim Dai, Professor, Georgia Institute of Technology, Atlanta, GA, United States of America, dai@isye.gatech.edu, Shuangchi He

In this survey paper, we focus on G /GI / n+GI parallel-server queues that serve as a building block to model call center operations. We survey recent results on the many-server queues that are operated in the QED and ED regimes. These results include the performance insensitivity to patience time distributions and diffusion and fluid approximate models as practical tools for performance analysis.

4 - A Survey of Stackelberg Differential Game Models in Supply and Marketing Channels
Xiuli He, The University of Texas at Dallas, United States of America, xiulihe@utdallas.edu, Genaro J. Gutierrez, Ashutosh Prased, Suresh Sethi

In this paper, we survey recent applications of Stackelberg differential game models to the supply chain management and marketing channels literatures. A common feature of these applications is the specification of the game structure: a decentralized channel composed of a manufacturer and independent retailers, and a sequential decision procedure with demand and supply dynamics and coordination issues.

■ TA15

Level 2 - Room 203

Best Student Paper Award – Finalists, Service Science Section

Sponsor: Service Science

Sponsored Session

Chair: Gregory Heim, Associate Professor, Texas A&M University, INFO Department Mays Business School, 320 Wehner Building 4217 TAMU, College Station, TX, 77843-4217, United States of America, GHeim@mays.tamu.edu

1 - Student Best Paper Award Session – Finalist Competitive Presentations, Service Science Section:
Gregory Heim, Associate Professor, Texas A&M University, INFO Department Mays Business School, 320 Wehner Building 4217 TAMU, College Station, TX, 77843-4217, United States of America, GHeim@mays.tamu.edu

The Service Science Section annually sponsors a "Best Student Paper" research award competition for students. The presenters in this session will be invited by a committee of service scholars, based on the students' submitted manuscripts. In this session, invited finalists will present their research studies, and a panel of distinguished service scholars will determine the rank ordering of winners. Winners will then be announced at the Service Science Section's business meeting.

2 - The Design of Experiential Services with Acclimation and Memory Decay: Optimal Sequence and Duration
Aparupa Das Gupt

We address the optimal sequence and duration of activities in a service encounter where customer perceptions of experience are important, as in the hospitality, leisure, and entertainment industries. We employ evidence from behavioral studies about how people evaluate past experiences. We model these phenomena parsimoniously and design service processes to maximize ex-post customer satisfaction.

3 - Traffic-Based Labor Planning in Retail Stores
Howard Hao-Chun Chuang, Assistant Professor, National Chengchi University, 64 Sec. 2, Zhinan Rd., Wenshan District, Taipei, 11605, United States of America, hchuang@mays.tamu.edu

To improve retail staffing decisions, we perform a comprehensive empirical study using a proprietary panel dataset. We develop a response function to quantify the impact of labor and traffic on sales, and formulate a profit maximization problem to help retailers determine labor requirements. The heuristic performs closely to the optimal staffing levels and outperforms current staffing practices.

4 - Dynamic Customer Acquisition and Retention Management
Gregory King, University of Michigan, United States of America, gjking@umich.edu

In consulting, finance, and other service industries, customers represent a revenue stream, and must be acquired and retained over time. In this paper, we study the resource allocation problem of a profit-maximizing service firm that dynamically allocates its resources towards acquiring new clients and retaining unsatisfied existing ones.

5 - Should Event Organizers Prevent Resale of Tickets
Yao Cui, University of Michigan, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, cuiyao@umich.edu

We are interested in whether preventing resale of tickets benefits the capacity providers for sporting and entertainment events. Common wisdom suggests ticket resale is harmful. Surprisingly, we find that this wisdom is incorrect when event organizers use fixed pricing policies. We propose ticket options as a means to increase event organizer revenues.meeting.

■ TA16

Level 2 - Room 204

Applications of Stochastic Optimization in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Anahita Khojandi, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, United States of America, ank83@pitt.edu

Co-Chair: Lisa Maillart, Associate Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, maillart@pitt.edu

1 - Optimization of Personalized Prostate Cancer Screening Based on PSA Dynamics
Daniel Underwood, North Carolina State University, North Carolina State University, Raleigh, United States of America, daniel.underwood@ncsu.edu

We present a simulation optimization model for optimal design of personalized prostate cancer screening policies that account for multiple cancer grades, demographic- and comorbidity-based risk factors, family history, and changes in PSA over time. We describe methods for solving the model based on the combined use of a genetic algorithm, COMPASS, and OCBA. Numerical results are presented to show the relative benefits of incorporating personalized risk factors as compared to current guidelines.

2 - Optimal Patient-centered Response to Acute Physiological Deterioration of Hospitalized Patients
Muge Capan, North Carolina State University, 400 Daniels Hall College of Engineering, Raleigh, NC, United States of America, mcapan@ncsu.edu, Julie Ivy

Hospitalized patients are at risk of acute physiological deterioration as characterized by abnormal vital signs. Current triggers for activating medical emergency teams have many false positive results. Using patient-specific information may result in higher specificity and personalized care processes. We develop semi-Markov decision process models to capture the dynamic nature of physiologic deterioration and optimize resuscitation decisions. Optimal policies suggest a control limit structure.

3 - Dynamic Abandon/ Extract Decisions for Failed Cardiac Leads
Anahita Khojandi, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, United States of America, ank83@pitt.edu, Lisa Maillart, Oleg Prokopyev, Mark Roberts, Samir Saba

Physicians must immediately implant a new cardiac lead for every lead that fails and extract all implanted leads if infection occurs. When a failure occurs, physicians may elect to extract the newly failed lead and/or any previously abandoned leads to (1) maintain space in the artery and (2) limit the leads dwell-times, the most critical factor in extraction complication. We develop Markov decision process models to determine patient-specific extraction policies for various cardiac device types.

■ TA17

Level 2 - Room 205A

Service System

Sponsor: Service Science

Sponsored Session

Chair: Manjunath Kamath, Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, m.kamath@okstate.edu

1 - Robust Service System Design

Juan Ma, Ph.D. Student, Oklahoma State University, 26 N University Place Apt. 8, Stillwater, OK, 74075, United States of America, juam@ostatemail.okstate.edu, Ying Tat Leung, Manjunath Kamath

In designing a service system it is critical to balance the cost invested in building and maintaining the system while meeting the system performance requirements specified in the service level agreement. In most cases, input parameters such as demand rate are uncertain and values used for solution design are subject to estimation error. We study the service system design problem using queueing models and prevailing risk measures to yield robust designs that minimize the total lifetime cost.

2 - Sequential Infrastructure Investments: Big vs. Small

Tim Leung, Assistant Professor, Columbia University, IEOR Department, 500 West 120th Street MC4704, New York, NY, 10027, United States of America, tl2497@columbia.edu, Eric Dahlgren

The energy & material processing industries are traditionally characterized by very large-scale physical capital with long lead times & long lifetimes. However, recent technological advancement in low-cost automation permits parallel operations of large numbers of small-scale production units. Such a paradigm shift motivates the analysis of the combined effect of lead time & lifetime on infrastructure investment decisions under uncertainty.

■ TA18

Level 2 - Room 205B

Recommendation

Sponsor: Service Science

Sponsored Session

Chair: Abhijeet Ghoshal, University of Minnesota, 19th Ave. S., Minneapolis, United States of America, abhijeet@umn.edu

1 - Intent-based Online Recommendation

Changrui Ren, Senior Manager, IBM Research China, Zhongguancun Software Park, Beijing, China, rencr@cn.ibm.com, Tao Qin, Miao He, Jinfeng Li, Bing Shao

The prevailing of collaborative filtering recommendation brings about tougher marketing competition for e-B2C retailers. The failure to capture and fulfill a customer's intents becomes an observed and announced pain point of a great many retailers. In contrary, the understanding of customer intents becomes a differentiator to cement the customer relationship, increase conversion rate and win market share. We share in-depth intent-based online recommendation in this work.

2 - Targeting in Online Advertising Markets

Nabita Penmetsa, Doctoral Candidate, University of Pittsburgh, Joseph M.Katz Graduate School of Busines, Mervis Hall, Pittsburgh, PA, 15260, United States of America, Npenmetsa@katz.pitt.edu, Esther Gal-Or

Internet platforms are collecting huge amount of data about customers, using various tracking technologies. This information can improve the effectiveness of online advertising and attract advertisers to the platform. However, consumer privacy concerns can limit the level of targeting that can be used by platforms. In the presence of this trade-off, we analyze the targeting and pricing decisions of competing platforms in a two-sided market model with heterogeneity on both sides of the platform.

3 - Recommendations using Information from Multiple Association Rules: A Probabilistic Approach

Abhijeet Ghoshal, University of Minnesota, 19th Ave. S., Minneapolis, United States of America, abhijeet@umn.edu, Sumit Sarkar, Syam Menon

In this paper, we propose a method to improve the quality of recommendations made using association rules. This is accomplished by combining rules when possible using a technique strongly grounded in probability theory. Combining rules requires identification of the best combination of rules. We use a maximum-likelihood framework to compare alternative combinations. We empirically show that our proposed approach performs better than several existing rule based and non-rule based approaches.

■ TA19

Level 2 - Room 205C

Capacity Optimization in Queueing Systems

Sponsor: Applied Probability

Sponsored Session

Chair: Itai Gurvich, Associate Professor, Northwestern University, 2001 Sheridan Road, Evanston, IL, United States of America, i-gurvich@kellogg.northwestern.edu

1 - Many-server Heavy-traffic Limits for Time-varying Queueing Networks with Markovian Routing

Korhan Aras, PhD Student, Department of Industrial and Systems Engineering, North Carolina State University, Yunan Liu

We establish many-server heavy-traffic limit theorems for network queues allowing customer abandonment, general distributions, time-varying arrival rates, time-varying staffing levels, and customer feedbacks (after service completions) in a Markovian fashion. The limit theorems provide rigorous theoretical bases for effective fluid and diffusion approximations for the mean values and variances of performance functions such as queue lengths and waiting times.

2 - Staffing and Control of Instant Messaging Contact Centers

Jiheng Zhang, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, jiheng@ust.hk, Jun Luo

We study a new kind of customer contact centers where agents communicate with customers via instant messaging over the Internet rather than phone calls. A distinctive feature is that one agent can serve multiple customers simultaneously. We establish fluid approximations for such systems in the many-server heavy-traffic regime. The fluid limits, which involve a stochastic averaging principle, provide insights into the optimal staffing and control for such service centers.

3 - Using Estimated Patience Levels to Optimally Schedule Customers

Achal Bassamboo, Northwestern University, Kellogg School of Management, Evanston, IL, United States of America, a-bassamboo@kellogg.northwestern.edu, Ramandeep Randhawa

Customer impatience has become an integral component of analyzing services, especially in the context of call centers. As customers wait in the queue, an update can be formed on their willingness to wait, or patience, as time progresses. So, even though all customers may be identical when they just join the queue, as time progresses, they become differentiated on their further willingness to wait. In this talk, we characterize the optimal scheduling of customers based on their updated patience.

4 - Randomized Longest-queue-First Scheduling for Large-scale Buffered Systems

Tonghoon Suk, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, United States of America, tonghoons@gatech.edu, Ton Dieker

Motivated by a desire to analyze the tradeoff between performance and complexity of the randomized longest-queue-first scheduling algorithm in parallel-queuing systems with n buffers, we establish mean-field limit theorems as n goes to infinity. The limit theory developed in this presentation leads to a diffusion approximation for queue-length processes, and we show through simulation experiments that the resulting approximation is already quite accurate for moderate values of n.

■ TA20

Level 2 - Room 205D

Robust Stochastic Optimization

Sponsor: Applied Probability

Sponsored Session

Chair: Michael Kim, Postdoctoral Fellow, University of California-Berkeley, /NUS Business School, Berkeley, CA, United States of America, kimmi@ieor.berkeley.edu

1 - Learning Asymmetric Forecast Preference: Models and Empirical Study

Mengshi Lu, PhD Student, University of California at Berkeley, Department of IEOR, University of California, Berkeley, CA, 94720, United States of America, mengshi@berkeley.edu, Pin Ng, Kemal Guler, Z. Max Shen

Forecasters typically have asymmetric preference towards underforecast and overforecast. We present inverse and robust optimization models for recovering such asymmetry from historical forecast data. Simulated numerical study shows that our models are able to recover the true asymmetric preference efficiently. We then use the models to study the Federal Reserve's economic growth forecast and forecast sharing in a PC manufacturing supply chain.

2 - Robust Multi-armed Bandit Problems
Michael Kim, Postdoctoral Fellow, University of California-Berkeley, /NUS Business School, Berkeley, CA, United States of America, kimmi@ieor.berkeley.edu, Andrew Lim

We consider a robust formulation of the standard multi-armed bandit problem. We show that arms are no longer independent under the worst-case model, even if they are independent under the nominal. By adapting recent results from stochastic DP duality theory, we derive performance bounds for a robust version of the Gittins index policy. One general contribution of this work is that it provides methods for evaluating the performance of policies of interest in a robust dynamic optimization setting.

3 - Robust Markov Decision Processes
Wolfram Wiesemann, Imperial College, 180 Queen's Gate, London, SW7 2AZ, United Kingdom, ww@imperial.ac.uk, Berç Rustem, Daniel Kuhn

The practical use of Markov decision processes (MDPs) can be affected by their sensitivity to unknown distributional model parameters that have to be estimated by the decision maker. To counter the detrimental effects of estimation errors, we consider robust MDPs that offer probabilistic guarantees in view of the unknown parameters. To this end, we construct a confidence region for the parameters, and we determine policies that attain the best worst-case performance over this confidence region.

4 - Social Networks and Choice
Jeremy Chen, National University of Singapore, 15 Kent Ridge Drive, Singapore, 119245, Singapore, jeremy.chen@nus.edu.sg

I consider a simple choice model where multiple agents, connected in a recommendation network, make choices from a finite set. I obtain insights on how the network affects decision making, and efficiently computable analytical solutions that are absent from analyses of activation/cascade models. I show that for the "brand ambassador" selection problem, a natural greedy selection strategy produces solutions within 63% of optimal. I also demonstrate concavity of profit in the pricing setting.

■ TA21

Level 2 - Room 206

Rural Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Ashlea Bennett Milburn, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ashlea@uark.edu

1 - Optimal Physician Traveling Assignment for Improving Care Access in an Outpatient Care Network
Yan Li, West Lafayette, IN, United States of America, li528@purdue.edu, Qipeng Zheng, Nan Kong

We consider the problem of scheduling mental health consultation sessions at satellite clinics within an outpatient specialty care network to improve patients' access to care. We formulate the problem as a physician assignment dependent capacitated facility location problem. We develop several column generation based primal heuristics. Our experiments demonstrate conditions under which the idea of scheduling sessions at satellite clinics is appealing and show the efficiency of our algorithm.

2 - A Simulation Approach for Rural Patient Scheduling using a Healthcare Information Sharing System
Andy Banerjee, Associate Professor, Texas A&M University, Department of Industrial and Systems Eng, 3131 TAMUS, College Station, TX, 77843, United States of America, banerjee@tamu.edu, Hyeongsuk Na

Access to quality healthcare services is often a challenge for rural patients. It is even more challenging when a patient tries to make appointments with multiple providers. The underlying cause is related to the lack of timely sharing of patient medical information. A patient scheduling problem using a healthcare information sharing system is discussed here. A simulation analysis is used to model and analyze the problem providing insights into the value of shared information.

3 - Patient-focused Considerations in Home Health Nurse Routing Problems
Kunlei Lian, Graduate Research Assistant, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, klian@email.uark.edu, Ashlea Bennett Milburn

We present a study undertaken to quantify the costs of patient-focused considerations in home health nurse routing problems, such as nurse consistency, time consistency and time windows. We model these problems as vehicle routing problem variants. The magnitude of travel cost increase that results from introducing one or more of these considerations is studied. Computational results are presented for a variety of test instances.

■ TA22

Level 2 - Room 207

Descriptive and Prescriptive Models for Epidemic Growth using SIR Models

Cluster: Disease Progression

Invited Session

Chair: Esma Gel, Arizona State University, School of Engineering, Tempe, AZ, 85281, United States of America, Esma.Gel@asu.edu

1 - Optimal Spatial Control of Biological Invasions
Rebecca Epanchin-Niell, Resources for the Future, 1616 P St., NW, Washington, DC, 20009, United States of America, Epanchin-Niell@rff.org, James E. Wilen

We develop a spatially explicit susceptible-infected-susceptible (SIS) model of invasion spread dynamics. The model allows for invasion control via spread prevention and local eradication. We use the model to identify optimal spatial-dynamic control strategies for minimizing total invasion costs and damages and show how landscape geometry affects optimal approaches. In general, optimal control strategies slow or prevent invasion spread in the direction of greatest potential long-term damages.

2 - Protecting Forest Health: A Spatial SIR Model for Controlling Destructive Forest Insects
Robert Haight, USDA Forest Service Northern Research Station, 1992 Folwell Ave., St. Paul, MN, 55108, United States of America, rhaight@fs.fed.us

We model the spatial-dynamics of emerald ash borer (EAB) in Minneapolis-Saint Paul using a susceptible-infectious-resistant (SIR) framework for neighborhood ash trees. The model accounts for susceptible and infected trees over time and space based on growth and dispersal of EAB adults and phloem consumption by larvae. We use the SIR model to determine the location and timing of ash treatments and removals to maximize public benefits subject to the city's EAB control budget.

3 - Various Atypical Heterogeneous Structures for SIR Models
Benjamin Morin, Postdoctoral Researcher, Arizona State University, School of Life Sciences, Box 874501, Tempe, AZ, 85287-4501, United States of America, brmorin@asu.edu, Charles Perrings, Eli Fenichel, Carlos Castillo-Chavez

SIR models that account for distributed susceptibility, adaptive contact/mixing rates, and affinity are studied. We highlight the use of a variety of techniques in the modeling heterogeneities within an SIR context. Model outcomes are evaluated under random mixing and alternative forms of heterogeneity: qualitative equivalence, relative disease severity, and tractability.

4 - Stochastic Processes to Model Hospital Arrivals Due to an Epidemic
Esma Gel, Arizona State University, School of Engineering, Tempe, AZ, 85281, United States of America, Esma.Gel@asu.edu, Maria Rieders, Baykal Hafizoglu, Lerzan Ormeci

Susceptible-Infected-Recovered (SIR) models are commonly used to analyze the spread of epidemic, pandemic and infectious diseases. In this paper, we shed some light on the arrival process of patients at a hospital due to an epidemic. We modify a Markovian SIR model by assuming that infected patients seek help at a hospital at an exponential rate. We present a recursive formulation for the calculation of the Laplace transforms for the interarrival times for the sequence of patients seeking help.

■ TA23

Level 2 - Room 208A

Theory and Practice in Retail

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Georgia Perakis, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, United States of America, georgiap@mit.edu

1 - Assortment Optimization Algorithms for Non Parametric Choice Models
Vivek Farias, Professor, Massachusetts Institute of Technology, 100 Main Street, Cambridge, MA, 02142, United States of America, vivekf@mit.edu

The assortment optimization problem consists in determining the selection of products a seller offers that generates an optimal revenue. Whereas this problem is known to be NP-Hard in the general non parametric setting, we manage to provide efficient polynomial algorithms to solve it for large subfamilies of the non parametric customer choice model.

2 - Omni-channel Price Optimization
Pavithra Harsha, IBM Research, 1101 Kitchawan Road, Room 34-225, Yorktown Heights, NY, 10598, United States of America, pharsha@us.ibm.com, Shivaram Subramanian, Markus Ettl, Charles Ng

The face of retail is changing with consumers increasingly navigating through multiple channels to make purchases. Currently, retailers operate the different channels in silos. In our work, using real data from a retailer, we show the existence of cross channel price effects for several items in different categories. Our main contributions include the framework and an efficient and scalable method to perform an integrated omni-channel price optimization solution with a computational study.

3 - Pre-pack Optimization in Fashion Retail
Shivaram Subramanian, IBM Research, 1101 Kitchawan Road, TJ Watson Research Center, Yorktown Heights, United States of America, subshiva@us.ibm.com, Andrew Vakhutinsky, Alexander Kushkuley

The problem of pre-pack optimization arises when a fashion retailer has to deliver merchandise items to multiple stores in the chain having various demand profiles for size-color combinations. Items of the same style are packed using very few style-color configurations (pre-packs) determined prior to the selling season, then combined and shipped to each store to match its demand curve. We formulate a problem of determining an optimal pre-pack set and analyze several solution approaches.

4 - High Dimensional Revenue Management
Dragos Florin Ciocan, Massachusetts Institute of Technology, 100 Main Street, Cambridge, MA, 02139, United States of America, ciocan@mit.edu, Vivek Farias

This research is motivated by Ad-Display allocation. In practice, the dimensionality of the impression stream (up to a billion arrivals daily) makes traditional RM approaches intractable. We introduce a low rank model in which the number of impression types is exponential in some rank parameter. We present a scheme that learns a near optimal solution to the original allocation problem using a number of samples that is polynomial in the rank of the impression space and the number of advertisers.

■ TA24

Level 2 - Room 208B

Solution Methods for RM and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Sumit Kunnumkal, Indian School of Business, AC4 Level 1 4116, ISB, Hyderabad, AP, India, Sumit_Kunnumkal@isb.edu

1 - Pricing under the Multi-level Nested Logit Model
Huseyin Topaloglu, Cornell University, Frank H T Rhodes Hall, Ithaca, NY, 14853, United States of America, ht88@cornell.edu, Guang Li, Paat Rusmevichientong

We consider pricing problems under the multi-level nested logit model. We give a formulation of the multi-level nested logit model that works for any number of levels in the choice model. We describe a simple algorithm to find a set of prices that maximize the expected revenue and discuss convergence properties.

2 - An Approximate Dynamic Programming Approach to a Rolling-horizon Appointment Scheduling Problem
Dan Zhang, University of Colorado at Boulder, 995 Regent Dr, Boulder, CO, 80305, United States of America, Dan.Zhang@Colorado.EDU, Thomas Vossen

We consider approximation strategies for a rolling horizon appointment scheduling problem formulated as an infinite horizon discount dynamic program. First, we show that the approximate linear program from affine functional approximation admits a compact representation. Second, we consider a relaxation based on probabilistic allocation of demand, which can be solved as a one-dimensional dynamic program. Numerical results are provided.

3 - A New Compact LP Formulation for Choice Network RM
Sumit Kunnumkal, Indian School of Business, AC4 Level 1 4116, ISB, Hyderabad, AP, India, Sumit_Kunnumkal@isb.edu, Kalyan Talluri

We derive a new compact LP formulation for the choice network RM problem. Our LP gives an upper bound that is provably between the choice LP value and the affine relaxation, and often coming close to the latter in numerical experiments.

■ TA25

Level 2 - Room 208C

Allocation and Market Design

Cluster: Auctions

Invited Session

Chair: Thayer Morrill, North Carolina State University, Raleigh, NC, United States of America, thayer_morrill@ncsu.edu

1 - Mechanism Design for Scheduling with Uncertain Execution Time
Angelina Vidali, Duke University, Durham, NC, United States of America, angvid@gmail.com, Vincent Conitzer

We study the problem where a task must be executed, there are multiple machines/agents that can potentially perform the task, and our objective is to minimize the expected sum of the agents' processing times. Each agent does not know exactly how long it will take him to finish the task; he only knows the distribution from which this time is drawn. We construct a mechanism that makes it an ex-post equilibrium for the agents to both truthfully report their distributions and exert full effort.

2 - Failure-aware Kidney Exchange
John Dickerson, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15232, United States of America, dickerson@cs.cmu.edu, Ariel Procaccia, Tuomas Sandholm

Most algorithmic matches in fielded kidney exchanges do not result in an actual transplant. We address the problem of cycles and chains in a proposed match failing after the algorithm has committed to them. We show that failure-aware kidney exchange increases the expected number of lives saved in theory and in practice. We design a branch-and-price-based optimal clearing algorithm for this problem; this new solver scales well on large simulated data, unlike prior clearing algorithms.

3 - Symmetric Auctions
Rahul Deb, University of Toronto, Toronto, ON, Canada, rahul.deb@utoronto.ca, Mallesh Pai

Practical constraints often restrict auctions to being symmetric. We examine when this restriction prevents a seller from achieving his objectives. We characterize the set of incentive compatible and individually rational outcomes that can be implemented by a symmetric auction. We show that symmetric auctions can yield many discriminatory outcomes such as revenue maximization and affirmative action, and characterize the implementable outcomes when IR holds ex-post rather than in expectation.

4 - Two Simple Variations of Top Trading Cycles
Thayer Morrill, North Carolina State University, Raleigh, NC, United States of America, thayer_morrill@ncsu.edu

Top Trading Cycles is widely regarded as the preferred method of assigning students to schools when the designer values efficiency over fairness. However, there is a flaw in Top Trading Cycles: agents are allowed to trade for objects they are guaranteed to receive. Such a trade is not necessary and may cause a distortion in the fairness of the assignment. We introduce two simple variations of Top Trading Cycles in order to mitigate this problem.

■ TA26

Level 2 - Room 208D

Location Models I

Sponsor: Location Analysis

Sponsored Session

Chair: Dmitry Krass, Professor, Rotman School of Management, University of Toronto, Toronto, ON, M5S3e6, Canada, Krass@Rotman.Utoronto.Ca

1 - A Bi-objective Optimization Model for Designing Safe Walking Routes for School Children
Ken-ichi Tanaka, Assistant Professor, The University of Electro-Communications, 1-5-1, Chofugaoka, Chofu-shi, Tokyo, Japan, ken1tnk@se.uec.ac.jp, Yuichiro Miyamoto, Ryuhei Miyashiro

This paper addresses the design of safe walking routes to and from school for school children. Children are considered to be safer when walking together in groups rather than alone. We propose a bi-criteria model in which both the total risk (particularly, the total distance walked alone) and the total distance traveled by children are minimized. We apply the problem to road networks and analyze Pareto optimal solutions which provide a good compromise between safety and distance.

2 - Simple Continuous Approximations for Local-vs-Global Delivery
John Carlsson, University of Minnesota, 111 Church St., SE, Office 130C, Minneapolis, MN, 55455, United States of America, jgc@umn.edu

We consider the problem of designing an optimal hub-and-spoke network in continuous Euclidean space: the "spokes" of the network are distributed uniformly over a service region, and our objective is to determine the optimal hub configuration. We consider seven different backbone network topologies for connecting the hub nodes, namely the Steiner and minimum spanning trees, a TSP tour, a star network, a capacitated vehicle routing tour, a complete bipartite graph, and a complete graph.

3 - Maximizing Trading Area of a New Facility: The Planar Case
Dmitry Krass, Professor, Rotman School of Management, University of Toronto, Toronto, ON, M5S3e6, Canada, Krass@Rotman.Utoronto.Ca, Atsuo Suzuki

We consider adding a new facility to a region containing competitive facilities. The demand is assumed to be uniformly distributed. The objective is to find the location for a new facility that maximizes its trading area, which is equivalent to maximizing the area of the Voronoi cell for the new facility. We develop an exact solution method based on the Big Triangle - Small Triangle algorithm. Novel approach is used to develop upper bounds.

4 - A Network Design Model for Hub Location Problems
Armin Luer-Villagra, PhD candidate, Pontificia Universidad Catolica de Chile, Department of Electrical Engineering, Av. Vicuña Mackenna 4860, Santiago, Chile, arminluer@gmail.com, Guillermo Latorre-Nuñez, Vladimir Marianov

We propose a mixed-integer programming model for a hub location problem, formulated as a network design problem. The model determines the capacities required at both nodes (airports) and at arcs to carry the offered traffic. Instead of using an exogenous factor for economies of scale, the model applies discounts wherever the traffic is large enough. We solve the model using an exact method and a heuristic.

■ TA27

Level 2 - Room 209A

Raytheon Innovations in Military Operations Analysis

Sponsor: Military Applications

Sponsored Session

Chair: George Blaha, Senior Principal Systems Engineer, Raytheon Integrated Defense Systems, 2461 S. Clark St. #1100, Arlington, VA, 22202, United States of America, gblaha@raytheon.com

1 - A Value Proposition for Elevated Sensors
Daniel Wilson, Senior Principal Systems Engineer, Raytheon Integrated Defense Systems, 225 Presidential Way, Woburn, MA, 01801, United States of America, Daniel.D.Wilson@raytheon.com

Given the ever increasing demand for surveillance data, elevated sensors provide a cost effective contribution to any sensor portfolio due to their ability to cover large areas (reduced line-of-sight limitations). However, this correspondingly increases the risks incurred from an ever-growing reliance on limited numbers of ISR platforms. Thus utility theory yields an obvious mechanism to articulate a value proposition for elevated sensors given their capabilities, costs and vulnerabilities.

2 - Successful Business Execution - Strategic, Operational and Solutions Architecture Trifecta
Ripal Goel, Principal Systems Engineer, Raytheon Integrated Defense Systems, 6620 Chase Oaks Blvd., Plano, TX, 75023, United States of America, Ripal_Goel@raytheon.com

Increasing level of complexity in technical solutions, varying customer mission needs, and business goals with aggressive ROI, requires an integrated approach that allows for seamless business execution. Unfortunately, robust and smooth collaboration does not exist between the business, stakeholders and technical communities. The agile approach focuses on aligned architecture development. The trifecta and methodical approach influences business decisions, while providing best value solution.

3 - Including Cyber Warfare Effects in Military Mission Effectiveness Studies
George Blaha, Senior Principal Systems Engineer, Raytheon Integrated Defense Systems, 2461 S. Clark St. #1100, Arlington, VA, 22202, United States of America, gblaha@raytheon.com

The growing use of cyber warfare capabilities necessitates the inclusion of cyber effects into mission effectiveness studies. However, the maturity of cyber effects models lags behind that for traditional military elements (e.g., sensors and kinematic weapons). This presentation introduces the analytical challenge of assessing cyber warfare capabilities within a "classic" integrated air defense analysis and suggests some key considerations for integration of cyber operations into such analyses.

4 - Operational Information and Decision Analysis for Missile Defense Engagements: Model-Based Approach
Jay Finn, Principal Systems Engineer, Raytheon Integrated Defense Systems, 235 Presidential Way, Woburn, MA, 01801, United States of America, jayfinn@raytheon.com, Bobbi Young, Dan Gernert, Karyn Furlong

The BMDS operational architecture includes pre-planned engagement decisions executed independently without coordination between elements to optimize BMDS capabilities. Our goal was to model the operational architecture to understand information needs for time critical decisions. This presentation discusses our approach combining operational processes, architecture models, and timeline analysis, to identify opportunities to increase performance of future BMDS architectures.

■ TA28

Level 2 - Room 209B

Innovative Applications

Cluster: Data Envelopment Analysis

Invited Session

Chair: Wade Cook, York University, Schulich School of Business, Toronto, ON, Canada, wcook@schulich.yorku.ca

1 - Partial Input to Output Impacts in DEA: Resource Sharing among Business Sub-units
Wade Cook, York University, Schulich School of Business, Toronto, ON, Canada, wcook@schulich.yorku.ca, Raha Imanirad, Joe Zhu

While it is generally assumed in DEA that all outputs are impacted by all inputs, there are many situations where this may not be the case. For example, in a food manufacturing setting, certain foods are exempt from nutrition labeling and as a result are not influenced by labeling resources. This paper extends the conventional DEA methodology to allow for the measurement of technical efficiency in situations where only partial input-to-output impacts exist.

2 - Improving Forecasting Accuracy by Segmented Rate of Change (RoC) in Technology Forecasting using DEA
Dong-Joon Lim, Portland State University, Engineering and Technology Management, Portland, OR, 97201, United States of America, tgno3.com@gmail.com, Tim Anderson

Technology Forecasting using Data Envelopment Analysis (TFDEA) captures technological advancement from the evolution of the State Of the Art (SOA) frontier. This study proposes a procedure to improve the forecasting accuracy by capturing local rate of change for each frontier segment that represents different product families. This approach is illustrated using previously published applications including commercial airplanes, jet fighters, LCD panels, hybrid electric vehicles, and DSLR cameras.

3 - The Future of E-mail Processing. Making E-mail Effectiveness Right
Joe Castrovera, CEO, eRank Technologies, Melville, NY, United States of America, jcastro@erank.pro

eRank, The Effectiveness E-mail Processing App, provides concrete solutions for transforming e-mail overload into an integrated method of concentration. eRank was designed to make your organization concentrate on the e-mails that come first. Our innovative team-approach software allows users not only get their messages labeled – but also categorized by shared priority levels with an expected time of response for each. Rated by author E. Saunders as "A tool that really could be a game changer.

■ TA29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Ziena Optimization LLC - Using the KNITRO Tuner for Improved Performance

Richard Waltz, Ziena Optimization LLC, 1801 Maple Ave, Suite 6305, Evanston, IL, 60201, United States of America, waltz@ziena.com

KNITRO is the premier solver for nonlinear optimization problems. This software demonstration will highlight the new KNITRO Tuner forthcoming in KNITRO 9.0. The KNITRO Tuner will automatically tune and recommend non-default user option settings to obtain the best performance for difficult nonlinear optimization problems. Examples will be provided.

2 - FICO - Optimization on the FICO Analytic Cloud

Oliver Bastert, FICO, 2665 Long Lake Rd, Roseville, MN, 55113, United States of America, oliverbastert@fico.com

This demo will show you how to turn an optimization model into a full optimization application in minutes. As a second step we will demonstrate how to deploy this application on the FICO Analytic Cloud. Once an optimization model or application is hosted on FICO Analytic Cloud, others can subscribe to them and you can begin generating review with your valuable IP. Based on several examples, we show you how to start with an optimization model, create optimization scenarios, and compare and visually analyze the execution results from your PC or your mobile device.

■ TA30

Level 2 - Room 210B

Combinatorial Optimization

Contributed Session

Chair: Jose L. Walteros, University of Florida, 303 Weil Hall, Gainesville, FL, 32608, United States of America, jwalteros@ufl.edu

1 - Approximation Algorithms for Inventory Constrained Scheduling on a Single Machine

Ehab Morsy, University of Siegen, Dept. of Management Information Science, Holderlinstr. 3, Siegen, 57068, Germany, ehab.morsy@uni-siegen.de, Erwin Pesch

We consider the problem of scheduling a set of jobs on a single machine subject to inventory constraints, i.e., conditions that jobs add or remove items to or from a centralized inventory, respectively. Jobs that remove items cannot be processed if the required number of items is not available. We focus on scheduling problems on a single machine where the objective is to minimize the total weighted completion time. In this paper, we design 2-approximation algorithms for the problem.

2 - Solving Exactly Real-life Graph Optimization Problems by Propositional Logic Modeling

Andreas Wotzlaw, University of Cologne, Weyertal 121, Cologne, 50931, Germany, wotzlaw@informatik.uni-koeln.de

We show how propositional logic based modeling can successfully be applied for solving hard optimization problems on graphs. We present new exact methods for finding maximum k-clubs, used for network-based data mining and clustering, and for crossing minimization on tanglegrams, used in bioinformatics to compare evolutionary history of species. We conclude with an experimental comparison of our well-performing approach with several state-of-the-art methods, while evaluated on real-life graphs.

3 - Two Guards Problem in Curved Case

Yiming Wang, Texas A&M University, 809 San Saba Drive, College Station, TX, 77845, United States of America, kkelvin@tamu.edu

Visibility problem is a classic problem in computational geometry and usually discussed in polygon objects. In this presentation, we introduce locally-convex curved objects and solve a visibility problem called two guards problem in this case.

4 - Novel Integer Programming Formulations for the Set Cover with Pairs Problem

Sérgio Monteiro, Doctor in Sciences, UFRJ, r. São Clemente, 185, Apt. 1407, bloo 02, Rio de Janeiro, RJ, 22260001, Brazil, sergiomonteiro2005@yahoo.com.br, Abílio Lucena, Tibérius Bonates, Luidi Simoneti

We introduce a novel formulation for the set cover with pairs (SCP) problem, which is a generalization of the classical set cover problem. In the SCP problem elements of the ground set are covered by certain pairs of objects, rather than by single objects. In addition to an exact formulation, we propose a simpler inexact model, which can be used to produce feasible solutions at a lower computational cost.

5 - Integer Programming Models for the Multidimensional Assignment Problem with Star Constraints

Jose L. Walteros, University of Florida, 303 Weil Hall, Gainesville, FL, 32608, United States of America, jwalteros@ufl.edu, Chrysafis Vogiatzis, Eduardo Pasiliao, Panos Pardalos

We consider a variant of the multidimensional assignment problem (MAP) in which the optimal assignment is described as a set of stars. This problem arises in the context of multi-sensor multi-target tracking problems, where a set of measurements must be associated to a set of targets. First, we introduce a nonlinear program and its linearization, along with additional valid inequalities. Second, we state the MAP as a set partitioning problem, and solve it via branch and price.

■ TA31

Level 2 - Room 211A

Financial Regulation and Risk Management

Sponsor: Financial Services

Sponsored Session

Chair: Xianhua Peng, Assistant Professor, Hong Kong University of Science and Technology, Department of Mathematics, Hong Kong University of Science and Tech, Hong Kong, Kowloon, Hong Kong - PRC, maxhpeng@ust.hk

1 - Design of Risk Weights

Wanmo Kang, Professor, KAIST, Department of Mathematical Sciences, Daejeon, Korea, Republic of, wanmo.kang@kaist.edu, Paul Glasserman

Bank capital requirements are defined through bounds on risk-weighted assets. We investigate the effectiveness of such linear constraints in limiting portfolio risk and aligning regulatory and private objectives. We derive optimal weights and an adaptive implementation in which the regulator adjusts weights to changes in bank assets. We also derive macroprudential risk weights to mitigate procyclicality and analyze the use of a single weight vector to multiple banks with a concentration penalty.

2 - Simulation Metamodeling for On-demand Risk Measurements

Kyoung-kuk Kim, Assistant Professor, Korean Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon, 305-701, Korea, Republic of, catenoid@kaist.edu, Xi Chen, Barry Nelson

In this talk, we introduce the use of a simulation metamodeling technique for efficient estimation of risks and their sensitivities. In particular, stochastic kriging is employed to build metamodels for value-at-risk, expected shortfall, and their sensitivity surfaces. We also show how the standard stochastic kriging can be generalized to enhance the predictive performance of the MSE-optimal stochastic kriging predictor.

3 - Continuous-time Portfolio Choice when Risk is Measured by Weighted VaR

Xuedong He, Assistant Professor, Columbia University, 316 Mudd Building, 500 West 120th Street, New York, NY, 10027, United States of America, xh2140@columbia.edu

We study a continuous-time portfolio choice problem in which an agent, with or without the no-bankruptcy constraint, chooses among the portfolios that achieve a given expected terminal wealth target with the objective of minimizing the risk of his portfolio. The risk is measured by a so-called weighted value-at-risk (VaR), which is a generalization of both VaR and conditional VaR. We finally extend the model to the case in which the risk is represented by a law-invariant coherent risk measure.

4 - Mean or Median: An Implication for BIS Trading Book Capital Requirements

Xianhua Peng, Assistant Professor, Hong Kong University of Science and Technology, Department of Mathematics, Hong Kong University of Science and Tech, Hong Kong, Kowloon, Hong Kong - PRC, maxhpeng@ust.hk, Steven Kou

We propose a new risk measure called median shortfall. We show that (i) the median shortfall captures tail risk in an alternative way to that of the expected shortfall; (ii) the median shortfall is more robust than the expected shortfall with respect to small changes in the data; (iii) the estimation error of the median shortfall is much smaller than that of the expected shortfall. Hence, it is better to use the median shortfall than to use the expected shortfall in setting capital requirements.

■ TA32

Level 2 - Room 211B

Managing Technological Innovation: Exploring Multiple Perspectives

Sponsor: Technology Management

Sponsored Session

Chair: Tugrul Daim, tugrul@etm.pdx.edu

1 - Innovation Management Processes and Tools: A Case Study Approach from the Utility Industry

Jisun Kim, Bonneville Power Administration, 905 NE 11th Ave., Portland, OR, United States of America, jxkim@bpa.gov, Judith Estep

To manage innovation effectively a systematic process is required. Often these processes are independent of the industry and include identifying strategies, developing strategic portfolios, managing the projects, and finally moving from research and development (R&D) into application. A case study approach is used to describe an example of institutionalizing R&D management in the utility industry. Finally, lessons learned are captured to help researchers avoid similar barriers.

2 - Finding Your Business Partners with Machine Learning of Business Data

Yuya Kajikawa, Tokyo Institute of Technology, 3-3-6 Shibaura, Minato-ku, Tokyo, 108-0023, Japan, kajikawa@mot.titech.ac.jp, Junichiro Mori, Ichiro Sakata

Business development is vital for any firms. In this work, we develop a computational approach to find business partners based on firm profiles and transaction relationships among them. We applied machine learning techniques to model customer-supplier relationships. The results showed that our approach successfully found plausible suppliers, customers and outsources, and can support to develop one's own business in the complicated, specialized and rapidly changing business environments.

3 - A Multi-criteria Decision Model for Developing Technology Standards in the ICT Industry

Ramin Neshati, Engineering Manager, Intel Corporation, 2111 NE 25th Ave., Hillsboro, OR, 97124, United States of America, ramin.neshati@intel.com

Firms contribute their own or license others' Intellectual Property (IP) in building standards-based products. How do firms decide whether or not to join a standards organization in the face of IP-related risks? The literature is devoid of a decision model to address this question. Using the Analytic Hierarchy Process (AHP) and data derived from panels of experts representing ICT firms, a robust decision support model is developed that comprehends the critical decision criteria and alternatives.

4 - Developing a Strategic Policy Choice Framework

Leong Chan, Adjunct Faculty, Portland State University, Portland, OR, 97201, United States of America, vleongv@gmail.com, Tugrul Daim

The objective of this research was to construct a technology policy choice framework to formulate technology development strategies, linking prospective high-tech areas and various innovative resources to promote national S&T competitiveness and foster long term technological innovation. A hierarchical decision model was developed. This research focused on the fast developing Chinese pharmaceutical industry as a case study.

■ TA33

Level 2 - Room 211C

Military Asset Planning and Assessment

Cluster: Homeland Security/Defense

Invited Session

Chair: Chase Murray, Auburn University, Industrial & Systems Engineering, Auburn, AL, United States of America, ccm0022@auburn.edu

1 - Improving the Army's Joint Platform Allocation Tool

Emily Craparo, Naval Postgraduate School, 1411 Cunningham Road, Monterey, United States of America, emcrapar@nps.edu, John Harrop

The Army's Joint Platform Allocation Tool (JPAT) is an optimization model that determines the best way to allocate aerial reconnaissance and surveillance assets to fulfill current and future mission requirements. JPAT has informed critical resourcing decisions and guided the Army's future investment strategy. This talk describes some recent improvements to JPAT that have dramatically increased it computational efficiency while allowing new classes of assets to be modeled.

2 - Towards a Risk Sensitivity and Dynamic Games of Multi-agent Tracking and Synchronization Design

Khanh Pham, Senior Aerospace Engineer, Air Force Research Laboratory, Space Vehicles Directorate, 3550 Aberdeen Ave. SE, Kirtland Air Force Base, NM, 87117, United States of America, AFRL.RVSV@kirtland.af.mil

This talk presents a class of distributed stochastic multi-agent linear systems where local interconnections among self-directed agents are supported by communication graphs and local observations. Associated with autonomous agents are finite-horizon integral-quadratic-form costs for conflict-free coordination and cohesive object tracking. Optimal rules for ordering uncertain prospects are feasible for all self-directed agents with output-feedback Nash decision making and risk-averse utilities.

3 - Assessing and Standardizing Military Unit Readiness

Natalie Scala, Assistant Professor, Towson University, 8000 York Road, Towson, MD, 20723, United States of America, natalie.scala@gmail.com, Paul Goethals

One of the most difficult measurements to obtain with some level of accuracy is military readiness to provide defense. The U.S. military has a requirement for units to report an overall readiness rating based on many factors. This research examines the current readiness reporting method and proposes a new benchmarking system based on desirability functions from quality theory, assessing readiness on quantitative and qualitative scales with aggregation so that a holistic approach is taken.

4 - Extracting Actionable Intelligence from Social Media Streams

Chase Murray, Auburn University, Industrial & Systems Engineering, Auburn, AL, United States of America, ccm0022@auburn.edu, Justin Yates

This talk explores strategies for collecting, filtering, and (hopefully) making sense of data broadcast through social media streams (e.g., Twitter and Facebook). Such streams may provide early notice of critical homeland security-related events, enabling faster response to threats. We provide preliminary results from our efforts to incorporate information from embedded URLs and demonstrate the use of natural language processing to infer context from the data.

■ TA34

Level 2 - Room 211D

Efficient Learning in Stochastic Optimization

Sponsor: Simulation Society

Sponsored Session

Chair: Ilya Ryzhov, Assistant Professor, University of Maryland, 4322 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, iryzhov@rhsmith.umd.edu

1 - Learning to Optimize Via Posterior Sampling

Dan Russo, Stanford University, 215 Ayrshire Farm Lane, Stanford, CA, United States of America, dan.joseph.russo@gmail.com, Benjamin Van Roy

We consider the application of a simple posterior sampling algorithm to multi-armed bandit problems. The algorithm, also known as Thompson Sampling, can be applied to problems with large action spaces and complicated dependencies among action rewards. We establish a theoretical connection between posterior sampling and the popular upper confidence bound approach. This relationship yields insight into the algorithm's performance advantages, and leads to a number of new theoretical guarantees.

2 - Learning in Combinatorial Optimization: How and What to Explore?

Denis Saure, University of Pittsburgh, Pittsburgh, United States of America, dsaure@pitt.edu, Sajad Modaresi, Juan Pablo Vielma

We study sequential combinatorial optimization under model uncertainty. We show that for balancing the implied exploration vs exploitation trade-off it is critical to resolve the issue of what information to collect and how to do so. Our answer to these questions lies in solving an adjunct formulation, which looks for the cheapest solution-based optimality guarantee. We develop fundamental limit on performance, and develop an efficient policy implementable in real-time.

3 - The Exploration-exploitation Trade-off in the Newsvendor Problem

Juan Chaneton, Ph.D. Candidate, Columbia University, 3022 Broadway, New York, United States of America, jmc2274@columbia.edu

We study the multiperiod Newsvendor problem, where unmet demand is censored and demand distribution is initially unknown. We focus our analysis in assessing two gaps of interest: the full exploitation versus optimal policy gap and the uncensored versus censored optimal costs. We show that, for one of the few known tractable cases, neither gap is substantial, and we characterize their structural behavior. In particularw we conclude that there is no potential gain from exploring in this problem.

4 - Optimal Learning with Non-Gaussian Rewards
Zi Ding, Ph.D. Candidate, University of Maryland, University of Maryland, College Park, MD, 20742, United States of America, zding@math.umd.edu, Ilya Ryzhov

We propose a theoretical and computational framework for approximating the optimal policy in multi-armed bandit problems where the reward distributions are non-Gaussian. Optimal stopping theory is used to characterize the value of the optimal policy, using a free-boundary partial integro-differential equation, for exponential and Poisson rewards. We solve the PIDE numerically and illustrate solution properties.

■ TA35

Level 2 - Room 212A

Economy of the Crowd

Sponsor: E-Business

Sponsored Session

Chair: Gal Oestreicher-Singer, Tel Aviv University, 21 Hahachayot St., Ramat Hasharon, 47214, Israel, galos@tau.ac.il

1 - Playing Both Sides of the Market: Success and Reciprocity on Crowdfunding Platforms
Ohad Barzilay, Tel Aviv University, Ramat Aviv, Tel Aviv, 69978, Israel, ohadbr@tau.ac.il, David Zvilichovsky, Yael Inbar

Crowdfunding platforms enable the financing of projects by soliciting small investments from a large base of potential backers over the internet. We use data collected from Kickstarter, the largest crowdfunding platform, and find that owner's backing history has a significant impact on project financing. We find that projects created by active backers set higher goals, have higher success rates, attract more backers and collect more funds.

2 - Crowd-Squared: A New Method for Improving Predictions by Crowd-sourcing Google Trends Keyword Select
Shachar Reichman, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, United States of America, shachar@mit.edu, Tomer Geva, Erik Brynjolfsson

Information from the "crowd", such as Google Trends, had been successfully used to accurately predict a wide variety of events. Nevertheless, a major challenge is the generation of an appropriate list of search terms that resemble the phenomena of interest. We introduce Crowd-Squared, a new crowd-based method, for selecting relevant search terms. We show that this method is successful in various domains and that it performs as well or even outperforms selection methods used in previous studies.

3 - "Please Comment Here" – Initiated Participation and Willingness to Pay on Content Websites
Lior Zalmanson, Tel Aviv University, Ramat Aviv, Tel Aviv, Israel, zalmanso@post.tau.ac.il, Gal Oestreicher-Singer

We investigate the effect of acts of initiated participation "calls to action" made by website owners on users' willingness to pay on content websites. We show that users who are given the calls of action in increasing order of effort are willing to pay more for a monthly subscription compared to users who are not exposed to such prompts. "Calls" given in any other order, do not yield significant results. Moreover, the "calls" do not interfere with users' appreciation of the content website.

4 - Framing, Privacy Settings, and the Limitations of Choice in Addressing Consumer Privacy Risks
Idris Adjerid, Carnegie Mellon University, 500 Forbes Avenue, Hamburg Hall, Pittsburgh, PA, 15123, United States of America, iadjerid@andrew.cmu.edu, Alessandro Acquisti, George Loewenstein

The collection of personal information by online firms presents an opportunity to uncover insights about consumers but also raises consumer privacy concerns. Policy makers posit that increased consumer choice will alleviate these concerns and reduce risks. We find that subtle variation in the framing of privacy relevant choices can predictably impact the choice of privacy protective options. Our result suggests that choice alone, may not be enough to address consumer privacy concerns.

■ TA36

Level 2 - Room 212B

Public Services and Operations Research

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Laura McLay, Associate Professor, University of Wisconsin-Madison, Industrial & Systems Engineering, Madison, WI, 53706, United States of America, lmclay@wisc.edu

1 - Improving Drinking Water Quality in Pinellas County via Optimized Flushing
Long Zhao, University of South Florida, 4202 East Fowler Avenue, ENC2400, Tampa, FL, 33620, United States of America, longzhao@mail.usf.edu, Bo Zeng, Xiongfei Xie

The Pinellas County water distribution system is suffering from water aging that affects 500,000 residents. This problem results from decreased water consumption in recent years. In this presentation, simulated annealing will be applied to obtain an optimal fire hydrant flushing schedule and thus maintain water quality and system integrity in Pinellas County. This project is supported by USF graduate student challenge grant.

2 - Time Series Models for High Frequency Integer-valued Data; Applications in EMS Call Forecasting.
Spencer Hays, Assistant Professor, Virginia Commonwealth University, 1015 Floyd Avenue, Harris Hall, Room 4130, Richmond, VA, 23284-3083, United States of America, shays@vcu.edu

With the increasing sophistication of data collection, count data can be reliably collected to a near infinitesimal degree of fineness. With such high frequency of measurement, it is more realistic that measured data are discrete samples of continuous processes, rather than discrete Poisson processes. Applications include EMS call forecasting and other big data problems.

■ TA37

Level 2 - Room 213A

Airport Operations Management

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Rainer Kolisch, Professor, Technische Universität München, Arcisstr. 21, München, Ba, 80333, Germany, rainer.kolisch@wi.tum.de

1 - The Airport Ground Staff Tour Scheduling Problem Based on Flexible Cyclic Work Templates
Ferdinand Kiermaier, PhD Student, Technische Universität München, Arcisstr. 21, München, Ba, 80333, Germany, ferdinand.kiermaier@wi.tum.de, Markus Frey, Jonathan Bard, Rainer Kolisch

We consider the airport ground staff tour scheduling problem. The tour generation is based on flexible cyclic work templates - a new rostering approach which differs from classical cyclic and non-cyclic tour generation. For the shift generation, we include fractionable breaks (see Rekik 2010), that is breaks which are not required to be attributed as a whole but can be divided into fractions. A MIP formulation and a column-generation based solution method are presented.

2 - Outbound Baggage Handling with Work Group Pairings
Markus Frey, Technische Universität München, Arcisstr. 21, München, Ba, 80333, Germany, markus.frey@wi.tum.de, Rainer Kolisch, Marco E. Luebbecke

We consider the outbound baggage handling planning problem at airports. We present an integrated binary model for the assignment and scheduling of flights to handling facilities and the staffing of ground handlers which levels the workload across all carousels and reduces the number of temporary workers.For solving the problem we propose a Dantzig-Wolfe decomposition and report computational results for real-world instances.

3 - Towing Processes at Airports – What is the Optimal Fleet Mix?
Jia Yan Du, Technische Universität München, Arcisstr. 21, München, Ba, 803333, Germany, jia-yan.du@wi.tum.de, Rainer Kolisch, Jens Brunner

Towing tractors are required to push plans off the gate before departure. Tractors differ with respect to investment costs, variable costs and plane type compatibility. We address the question of the cost minimal fleet mix. For this we introduce a MIP which takes into account a maximum lifetime, an overhaul option and a sell option. In a case study we derive an optimal fleet (de-)investment plan for a towing service provider at a cooperating airport considering various demand forecast scenarios.

4 - Operational Stand and Gate Allocation
Tor Fog Justesen, Industrial PhD Student, Copenhagen Airports A/S, Lufthavnsboulevarden 6, Kastrup, 2770, Denmark, tor.justesen@cph.dk, Jesper Larsen

We address the handling of aircraft turn-rounds in airports at the operational level. The processes involved in the handling of a turn-round require different ground handling resources at different times. Each resource can be claimed by at most one turn-round at a time. We develop a flexible set packing-based model formulation of the problem and a solution algorithm in which columns are generated by a KPI-based column generator to provide near-optimal feasible solutions efficiently.

■ TA38

Level 2 - Room 213B

Building MCDM Models: Practical and Methodological Issues

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Adiel Almeida, Prof, Universidade Federal de Pernambuco, Cx. Postal 7462, Recife, PE, 50.630-970, Brazil, almeidaatd@gmail.com

1 - Analysis of Water Losses: A Group Decision Sorting Approach
Danielle Morais, Assistant Professor, Federal University of Pernambuco, Rua Conselheiro Portela, 169/701, Recife, 52020-030, Brazil, daniellemorais@yahoo.com.br, José Figueira, Adiel Almeida

The immediate consequence of an inadequate maintenance plan of water supply systems is a high index of water losses. In these kind of problems is frequent to consider opinions of different managers from Water Companies. This study proposes a group decision sorting multicriteria model, based on SMAA TRI method, for categorizing the network in zones where losses are intense and thus focus the managers' effort on the most critical regions.

2 - An Application of a MCDM Model in a Supplier Selection Problem
Adiel Almeida-Filho, Assistant Professor, Universidade Federal de Pernambuco, Caixa Postal 7471, Recife, PE, 50630971, Brazil, atalmeidafilho@yahoo.com.br, Jönatas Almeida, Ana Paula Cabral, Adiel Almeida

This work presents an application of a model resolving criteria influence by flexible elicitation in a case study for a supplier selection problem. Supplier selection is naturally multicriteria decision problem that considers besides costs, strategic factors that influence the operation success. With the outsourcing trend growing along organizations this is a situation that arise frequently in the literature.

3 - Solving the Problem of Plaster Waste Destination in Buildings Sites Structured by VFT
Luciana Hazin, Assistant Professor, Federal University of Pernambuco, Recife, Brazil, alencarlh@gmail.com, Ana Paula Costa

Value-focus thinking is a methodology that addresses how values can be used to improve the decision making process. It was applied in the problem of plaster waste destination in the building sites in Brazil. It was possible for the parties involved in the problem to clarify their objectives and specify more precisely the consequences and constraints for the decision problem. With the problem structured, an additive model was applied using a new procedure for elicitation.

4 - Value Function Scales Problems in MCDM Portfolio Analysis
Adiel Almeida, Prof, Universidade Federal de Pernambuco, Cx. Postal 7462, Recife, PE, 50.630-970, Brazil, almeidaatd@gmail.com, Jönatas Almeida, Rudolf Vetschera

This work present an analysis on value function scales problems for selection of project portfolio based on multicriteria decision making (MCDM) methods. Two aggregating methods are considered: additive method and an outranking method, which uses a non-compensatory rationality, while the former corresponds to a compensatory one. Problems related to scales used for intra-criteria evaluation are considered, which is linked to inter-criteria elicitation in the case of additive methods.

■ TA39

Auditorium 3

Joint Session RAS/TSL: Railroad OR Models

Sponsor: Railway Applications & Transportation Science & Logistics

Sponsored Session

Chair: Clark Cheng, Director Operations Research, Norfolk Southern Corporation, 1200 Peachtree St., NE, Mail Stop 12-117, Atlanta, GA, 30022, United States of America, clark.cheng@nscorp.com

1 - Agent-based Traffic Optimization Model for Rail Terminal Management
Tie Shi, Student, Southwest Jiaotong University/ University of Utah, MCE Building 2135, 110 S. Central Campus Dr., Salt Lake City, UT, 84112, United States of America, tie.shi1986@gmail.com, Xuesong Zhou

This talk presents an agent-based integer programming formulation to represent the terminal station operation process, and the goal is to reduce overall train waiting time and delay penalty in the complex terminal network. A Lagrangian relaxation based solution method is developed to decompose the original complex problem into a sequence of easy-to-solve linear programming problems.

2 - Meet-pass Planning Model for Rail Capacity Analyzer
Hyun-suk Yoon, Operations Research Specialist, Norfolk Southern Corporation, 1200 Peachtree St., NE, Atlanta, GA, 30022, United States of America, Hyun-Suk.Yoon@nscorp.com, Clark Cheng, Akshat Dimri

We describe a railroad corridor capacity planning model that determines the practical capacity of a line segment on freight railroad. A tool based on this model has been utilized for the last few years at Norfolk Southern to assist with decision making in infrastructure improvement.

3 - Formulation and Solution Approach of Railcar Classification and Connection in Hump Yards
Mingzhou Jin, Associate Professor, The University of Tennessee at Knoxville, 405 East Stadium Hall, Knoxville, TN, 37996, United States of America, jin@utk.edu, Haodong Li, Rui Song

The hump sequencing and railcar connection in a railroad hump yard are considered together to minimize the total connection cost of priority-based railcars from inbound trains to outbound trains. The outbound trains are restricted by various size limitations, such as car number, length, and weight. A heuristic method based on the harmony search is used. A case study shows that the first-come (first-depart) first-serve rule is not always optimal to hump inbound trains (form outbound trains).

4 - Next Generation Analytics Applications for Railroads
Ravindra Ahuja, President & CEO, Innovative Scheduling, 2153 SE Hawthorne Road, Gainesville, FL, 32641, United States of America, ravindra.ahuja@innovativescheduling.com, Jason Montgomery

CSX Transportation has realized the need of advanced analytic applications such as data analytics, data mining, and simulation to build game changing applications for railroads resulting in higher asset utilization. We will give overview and demonstrations of some such applications where we have been involved and outline our vision moving forward.

■ TA41

Level 1 -101A

Models of Consumer Behavior

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Pnina Feldman, University of California-Berkeley, 545 Student Services Bldg, #1900, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu

1 - Intertemporal Price Discrimination: Structure and Computation of Optimal Policies
Ilan Lobel, New York University, 44 West Fourth Street, New York, NY, 10012, United States of America, ilobel@stern.nyu.edu, Omar Besbes

We consider the problem of a firm selling goods over time to customers with heterogeneous patience levels. We let customer valuations be correlated with their willingness-to-wait and look for a dynamic pricing policy that maximizes the long-term revenue of the firm. We prove several structural properties of the optimal pricing policy and develop a dynamic programming algorithm that computes the optimal policy in polynomial time.

2 - Cyclic Pricing and Strategic Waiting in the Air-Travel Industry
Jun Li, Assistant Professor, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu, Serguei Netessine

Will consumers wait longer or shorter in face of volatile prices? Using individual-level web visitation and transaction data in the air-travel industry, we are able to observe not only the time of purchase but also the length of waiting before committing to a purchase. The study reveals a cyclical pricing pattern in the air-travel industry, and sheds light on the optimality of such pricing strategy based on the corresponding waiting patterns observed from strategic consumers.

3 - Revenue Management by Semi-parametric Estimation of Ticket Sales
Senthil Veeraraghavan, University of Pennsylvania, Wharton School, 3730 Walnut Street, Philadelphia, PA, United States of America, senthilv@wharton.upenn.edu, Necati Tereyagoglu

We develop a semi-parametric competing proportional hazard framework that models the dynamic effects of an organization's show and time related pricing decisions on the customer's propensity to purchase a ticket for a variety of shows during a specified timeframe. We test our model on ticket sales and seat pricing data for a season of 21 concerts from a leading performing arts organization. We suggest a discounting policy using these estimates.

4 - Pricing Reservations
Pnina Feldman, University of California-Berkeley, 545 Student Services Bldg, #1900, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu, Kate Ashley

Many firms offer reservations for service in future periods. Recently, some firms have started to charge for reservations by implementing different pricing strategies. This paper proposes two different reservation pricing schemes, characterizes optimal prices and revenues under each scheme, and discusses managerial implications.

■ TA42

Level 1 -101B

Sustainable Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: David Drake, Harvard Business School, Morgan Hall 425, Boston, MA, 02163, United States of America, ddrake@hbs.edu

1 - Dynamic Capacity Investment in Sustainable Technologies
Gilvan "Gil" Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu, Shanshan Hu, Mark Ferguson, Wenbin Wang

We consider a firm's dynamic capacity decisions given a portfolio of technology options (e.g., HEV and diesel trucks) when demand and fuel costs are stochastic, and there is usage-based capacity deterioration. We provide the analytical structure of the optimal policy, and provide managerial and policy insights based on actual data.

2 - Carbon Tariff Effects in Settings with Technology Choice and Foreign Production Cost Advantage
David Drake, Harvard Business School, Morgan Hall 425, Boston, MA, 02163, United States of America, ddrake@hbs.edu

Carbon tariffs have emerged as a possible mechanism to address carbon leakage concerns, imposing carbon costs on imports at the regulated region's border. I show that, when firms choose from discrete technologies and offshore facilities hold a production cost advantage, carbon leakage can result despite the implementation of a carbon tariff. However, when carbon leakage does occur under a carbon tariff, global emissions can decrease, which contrasts existing results and conventional wisdom.

3 - Measuring Consumer Willingness-to-pay for Socially Responsible Products
Leon Valdes, PhD Student, Massachusetts Institute of Technology, Sloan School of Management, Boston, MA, United States of America, lvaldes@mit.edu, Yanchong Zheng, Tim Kraft

We experimentally study whether consumers are willing to pay higher prices for products with more accurate information regarding their social benefits. We show that consumers' willingness to pay does not decrease with higher information accuracy, and it is non-decreasing in the expected value of social benefits. We compare our results to a scenario where competitive products with different prices and information accuracy are presented to the consumers.

4 - Recycling as a Secondary Market Strategy
Isil Alev, Georgia Institute of Technology, Atlanta, GA, United States of America, isilalev@gatech.edu, Vishal Agrawal, Atalay Atasu

We focus on the economic and environmental implications of recycling policy requirements on secondary market strategies and product design choices of durable good monopolist. Using well-established consumer and firm characteristics, our work shows that EPR policy may result in very different consequences than intended. Additionally, we analyze the effect of recent international export control mechanisms and find that partial bans cause adverse effects both in developed and developing countries.

■ TA43

Level 1 -101C

Information and Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Li Chen, Duke University, Fuqua School of Business, 100 Fuqua Drive, Durham, NC, 27708, United States of America, li.chen@duke.edu

1 - Material Flow Variability in Supply Chains
Wei Luo, IESE Business School, Avenida Pearson, 21, Barcelona, Spain, wluo@iese.edu, Li Chen, Kevin Shang

We study the variability of shipment and sales in a multi-echelon supply chain. We show the conditions under which this variability will amplify or dampen along the supply chain. Our study bridges the gap between the theoretical and empirical research on the bullwhip effect.

2 - Secure Collaborative Planning Forecasting and Replenishment (SCPFR)
Vinayak Deshpande, Associate Professor, University of North Carolina, Kenan-Flagler School, Chapel Hill, NC, United States of America, Vinayak_Deshpande@kenan-flagler.unc.edu, Mikhail Atallah, Marina Blanton, Keith Frikken, Leroy Schwarz

Although the benefits of information-sharing are well known, many companies are averse to sharing their proprietary information due to fear of adverse impact from information leakage. This paper uses techniques from Secure Multiparty Computation to develop secure protocols for the CPFR business process. The result is a process that permits supply-chain partners to capture the benefits of information-sharing, but without disclosing their private information to one another.

3 - Bayesian Inventory Management with Potential Change-points in Demand
Zhe Wang, UNC Chapel Hill, CB 3490, Chapel Hill, NC, 27599, United States of America, zhe_wang@unc.edu, Adam Mersereau

We consider an adaptive inventory control problem in which at some known potential change-points, the demand process may change abruptly with some probability. The underlying demand process is never revealed to the decision maker. Using a Bayesian framework, we analyze the optimal policy as demands are observed. We construct two novel lower bounds which are used to develop two heuristics and to numerically evaluate their performance.

4 - Dynamic Pricing with Learning under Two-Sided Censoring
Li Chen, Duke University, Fuqua School of Business, 100 Fuqua Drive, Durham, NC, 27708, United States of America, li.chen@duke.edu

If a customer buys a product, you only know that her reservation price is greater than or equal to the posted price; if she does not buy the product, her reservation price must be below the posted price. Thus, from the seller's standpoint, the posted price serves as either a left- or right-censoring point of the customer's true reservation price. In this paper, we study how one can learn from such two-sided censored data and dynamically adjust prices to maximize total revenue.

■ TA44

Level 1 -101D

Supply Chain Management and Innovation

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Hyoduk Shin, UC San Diego Rady School of Management, 9500 Gilman Drive, La Jolla, CA, 92093, United States of America, hshin@rady.ucsd.edu

1 - Product Line Extensions and Technology Licensing with a Strategic Supplier

Steve Gilbert, Sam P. Woodson, Jr. Centennial Memorial Professor in Business, The University of Texas at Austin, The McCombs School of Business, Dept. of IROM, Austin, TX, 78793, United States of America, steve.gilbert@mccombs.utexas.edu, Liwen Chen, Yusen Xia

We consider how the introduction of a low-end version of an existing product can affect an OEM's interactions with a strategic supplier. We demonstrate how the low-end product line extension can induce a more favorable pricing from the supplier, and then show that, depending upon the cost structure and relative performance of the product line extension, the OEM may benefit even more from the low-end line extension if it is produced by a rival, even if no licensing revenue can be collected.

2 - Component Procurement Strategy in Assemble-to-Order Systems with Demand Forecast Updates

James Cao, Assistant Professor, University of Saskatchewan, Edwards School of Business, Room 88 PotashCorp Centre, 25 Campus Dr., Saskatoon, S7N 5A7, Canada, cao@edwards.usask.ca, Rick So

This paper examines the value of demand forecast updates in an assemble-to-order system in which the components have different procurement lead times. The manufacturer procures the components in sequence, and thus can take advantage of the latest forecast updates when ordering components with shorter lead times. We compare the expected profit with the no-updating case to determine the operating environment under which demand forecast updates could be most beneficial.

3 - Pricing and Revenue Optimization under a New Discrete Choice Model

John Semple, Southern Methodist University, Dallas, TX, United States of America, jsemple@cox.smu.edu, Aydin Alptekinoglu

We consider the pricing and revenue implications associated with a new discrete choice model based on ideal utilities. The model's structure produces a variety of clean analytical results and makes estimation with real data easy. We use the new choice model to estimate optimal revenues and optimal prices for a number of product assortments using data supplied by the company that initiated the project.

4 - Inclusive Innovation in Supply Chains: Contract Leadership and Product Life-cycle Perspective

Oleksiy Mnyshenko, University of California- San Diego, 9500 Gilman Drive, La Jolla, CA, 92093, United States of America, omnyshenko@ucsd.edu, Vish Krishnan, Hyoduk Shin

Examining inclusive innovation to increase market coverage including lower market segment, we study a supply chain with three tiers in which a firm in each tier can invest to increase a quality of product. For example, Tesla Motors as a tier-zero manufacturer has invested heavily on a tier two battery supplier skipping a tier one firm. Focusing on market coverage, we show that as a product matures along its life-cycle, it is better to hand over contract leadership to the higher tier suppliers.

■ TA45

Level 1 -101E

Capacity Management and Scheduling in Hospitals

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Retsef Levi, Massachusetts Institute of Technology, 100 Main St., E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

1 - Optimal Advanced Scheduling with Expediting

Van-Anh Truong, Columbia University, 500 West 120th St., New York, NY, 10027, United States of America, vatruong@ieor.columbia.edu

We consider the advanced scheduling of a generic resource to satisfy demand from two separate demand classes, an urgent demand class, which must be satisfied on the day of arrival, and a regular demand class, which can be satisfied on a future date. The problem is motivated by the scheduling of MRI exams in a pediatric hospital. We propose the first strategic use of expediting in advanced scheduling as a tool to increase operational flexibility and improve system efficiency.

2 - Modeling Hospital-wide Patient Flows using Simulation

Asli Ozen, PhD candidate, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, 01003, United States of America, aslozen@gmail.com, Hari Balasubramanian

In hospitals nationwide, misaligned bed capacity results in ED crowding and PACU holds. We used patient admission rates, surgery schedules, bed placement rules, length of stays and capacity information from Baystate Medical Center (Springfield, MA) to develop a simulation based optimization model to improve capacity allocation of inpatient beds. Our goal is to provide efficient discharge policies to manage the inpatient bed capacity in the presence of demand and LOS variability.

3 - The Surgical Patient Routing Problem

Sepehr Nemati, University of Pittsburgh, 4628 Bayard Street, Apt 302, Pittsburgh, PA, 15213, United States of America, SEN12@pitt.edu, Oleg Prokopyev, Andrew Schaefer, Oleg Shylo

Many patients face difficulties to access medical facilities in the U.S. To alleviate these difficulties, several medical centers offer shuttle services to patients. In this paper, we study an integrated routing and scheduling model for a stream of patients with outpatient surgery requests with the objective of minimizing the total service time cost for all the patients. Our numerical study reveals that health care providers can improve the quality of their services by our unified framework.

4 - Systematic Block Allocation in Large Academic Medical Centers

Cecilia Zenteno, Postdoctoral Fellow, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E62-389, Cambrdige, MA, 02139, United States of America, ceciliaz@mit.edu, Retsef Levi, Peter Dunn, Tim Carnes, Bethany Daily, Devon Price

We describe the large-scale implementation of data-driven surgical scheduling strategies at Massachusetts General Hospital. The strategies are based on a range of simulation and integer optimization techniques. The goals were to smooth the surgical census on the surgical floors and to increase timely access to non-elective patients. The models supported the changes in the scheduling practices, and delivered methodologies to study the changes in the respective performance metrics.

■ TA46

Level 1 -101F

Operations and Finance Interface

Sponsor: Manufacturing & Service Operations Management/IFORM

Sponsored Session

Chair: Fehmi Tanrisever, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, F.Tanrisever@tue.nl

1 - Dynamic Customer Base Management: Acquisition, Retention and Risk Diversification

Lu Huang, Duke University, 215 Butler Court, Chapel Hill, NC, 27514, United States of America, lu.huang2@duke.edu, Jeannette Song

We consider a manufacturer with finite capacity serving business customers in a dynamic environment. The customers differ in business volume, profit margin, loyalty and disruption risk profiles. We characterize the optimal customer portfolio and capacity rationing policy for the manufacturer. Some of the findings are counter-intuitive.

2 - The Entrepreneurial Newsvendor: Impact of Information Asymmetry on Debt, Hedging and Profitability

Fehmi Tanrisever, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, F.Tanrisever@tue.nl, Sinan Erzurumlu, Nitin Joglekar, Moren Levesque

We examine production problem in a special setting, termed the Entrepreneurial Newsvendor. The newsvendor needs to raise debt to fund the R&D in the presence of information asymmetry. We show that the decision to defer investment in such R&D can be employed as an operational hedge against future under-production problems. Through such an operational hedge, the firm can also mitigate the effects of information asymmetry and create value by enhancing its access to capital.

3 - Dynamic Optimization of Short-term Financing with Reverse Factoring

Arun Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, A.Chockalingam@tue.nl, Fehmi Tanrisever, Matthew Reindorp

According to pecking order theory, firms resort to external sources to finance their operations when internal funds are limited. Firms may obtain short-term loans directly from banks or they may receive loans in the form of reverse factoring through the aid of other supply chain partners. We examine the trade-off between dynamically switching between traditional bank loans and reverse factoring as the risk-free rate of interest and customer demand fluctuate over time.

4 - Using Controlled Curtailment for Integrating Intermittent Renewable Generation

Majid Algwaiz, PhD Candidate, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, mmgwaiz@umich.edu, Xiuli Chao, Owen Wu

We study the integration of intermittent renewable energy plants that are compensated by production based subsidies in a supply function equilibrium model with generators of varying ramping capabilities. We find that reducing the subsidy dampens the intermittency effect through controlled curtailment of renewables, which cuts operational costs and improves the network balance. Curtailment can also reduce market power in an oligopoly, which has favorable operational and price ramifications.

■ TA47

Level 1 -101G

Service Design: Work Allocation, Task Sequencing, and Pricing

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Guillaume Roels, UCLA, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, guillaume.roels@anderson.ucla.edu

1 - Pricing Services with Uncertain Quality to Heterogeneous Customers

Sampath Rajagopalan, University of Southern California, Marshall School of Business, Los Angeles, United States of America, Srajagop@marshall.usc.edu, Hao Zhang, Guangwen Kong

We consider optimal pricing of outsourced services such as web design to two types of consumers with different valuations for service quality. Two different scenarios are considered with deterministic and stochastic quality where the service provider's effort is hidden. We compare and contrast different pricing schemes in terms of profits and quality offered to both types of consumers and identify the benefits and costs of hidden effort. We provide managerial guidelines for pricing of services.

2 - Virtual Call Centers

Serguei Netessine, Professor, INSEAD, Boulevard de Constance, Fontainebleau, France, serguei.netessine@insead.edu, Konstantinos Stauras, Karan Girotra

We study the high-performance virtual call center business model (cf. LiveOps). Incoming calls are directed in real-time to work-from-home agents. Agents are ranked based on performance—higher ranked agents get more calls and agents are paid only for the time on the call. We model the system as an M/M/N system with ranked servers and study the role of different ranking schemes. Contrary to conventional wisdom, we find that less meritocratic schemes outperform more meritocratic schemes.

3 - The Design of Multi-Stage Service Processes

Stelios Kavadias, Professor, Cambridge Judge Business School, Trumpington Street, Cambridge, United Kingdom, sk747@hermes.cam.ac.uk, Ioannis Bellos

Motivated by the practices of design firms we build on the customer journey concept, which describes services as multi-stage processes. We develop a parsimonious model and we analyze the provider's decisions on the amount of effort she exerts at each stage of the process and the overall price she charges.

4 - The Design of Experiential Services: Optimal Sequence and Duration of Service Activities

Aparupa Das Gupta, PhD Candidate, University of California-Los Angeles, Anderson School of Management, 110 Westwood Plaza, Los Angeles, CA, United States of America, aparupa@ucla.edu, Uday Karmarkar, Guillaume Roels

We address the optimal sequence and duration of activities in a service encounter where customer perceptions of experience are important, as in the hospitality, leisure, and entertainment industries. We employ evidence from behavioral studies about how people evaluate past experiences. We model these phenomena parsimoniously and design service processes to maximize ex-post customer satisfaction.

■ TA48

Level 1 -101H

Opportunities in Behavioral Operations: Different Perspectives

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Andrew Davis, Assistant Professor, Cornell University, Ithaca, NY, 14853, United States of America, adavis@cornell.edu

1 - Opportunities in Behavioral Service Operations

Gad Allon, Professor, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu

I will discuss models in service operations and empirical anomalies with emphasis on opportunities for behavioral research and experiments. Specific attention will be given to the areas of customer decision making, pricing, and delay announcements.

2 - Research Opportunities Related to Behavioral Operations in Healthcare

Anita Tucker, Associate Professor, Harvard Business School, Morgan Hall 413, Soldiers Field, Boston, MA, 02163, United States of America, atucker@hbs.edu

Healthcare organizations struggle to provide high quality care as efficiently as possible. These organizations seek to standardize the work of healthcare providers while also maintaining flexibility and creativity to treat patients as individuals. Patient compliance is also a major concern. This talk will explore research opportunities to use field and laboratory to examine issues related to behavioral operations in healthcare settings.

3 - Behavioral Newsvendor Decisions: What Have We Learned and What is Left to Do?

Gerard Cachon, Professor, University of Pennsylvania, Wharton School, Philadelphia, PA, United States of America, cachon@wharton.upenn.edu

Ask somebody to make a newsvendor problem decision and they are likely to order a quantity that is closer to expected demand than optimal. This "pull to the center" effect has been the focus of numerous studies. This talk discusses what we know about this effect and what seems to be missing.

■ TA49

Level 1 -101I

Performance Variability in Mixed-integer Programming

Cluster: Tutorials

Invited Session

Chair: Andrea Lodi, Professor, DEI, University of Bologna, Viale Risorgimento, 2, Bologna, 40136, Italy, andrea.lodi@unibo.it

1 - Performance Variability in Mixed-integer Programming

Andrea Lodi, Professor, DEI, University of Bologna, Viale Risorgimento, 2, Bologna, 40136, Italy, andrea.lodi@unibo.it, Andrea Tramontani

The performance of MIP solvers is subject to unexpected variability that appears, e.g., when changing from one computing platform to another, when permuting rows and/or columns of a model, etc. This phenomenon, observed for decades, has only recently started to be methodologically analyzed. We discuss the roots of performance variability, we provide tips to recognize it, and we point out some severe benchmarking misinterpretations. Finally, we report on recent attempts to gain from variability.

■ TA50

Level 1 -101J

Energy III: Management of Power Systems

Contributed Session

Chair: Mark Rodgers, Rutgers University, Rutgers University, Piscataway, NJ, 08854, United States of America, mdrodgers07@gmail.com

1 - Modeling Inflows for SDDP Hydro-electric Scheduling Problems
Geoffrey Pritchard, University of Auckland, Dept of Statistics, Private Bag 92019, Auckland, New Zealand, g.pritchard@auckland.ac.nz

Hydro-electric scheduling problems formulated as stochastic dual dynamic programs (SDDP) depend heavily on their water-inflow models. We present some examples showing that small details of the inflow model (e.g. the parameter-estimation method used, or the way residuals are re-sampled) can have a large effect on the optimal solutions found. In particular, computed energy prices can be very sensitive to the way inflows are modelled.

2 - Choice of Storage Technology for an Electrical System
Santhosh Suresh, University of Michigan, 701 Tappan, Ann Arbor, United States of America, sssandy@umich.edu, Roman Kapuscinski, Owen Wu

Given portfolio of various types of storage technologies differing in investment cost per unit storage capacity and conversion efficiency, we consider the problem of choosing which type of technology to invest in. We show that a profit maximizing firm would choose a single type of technology while social planner minimizing total system cost may invest in multiple technologies and characterize optimal portfolios of storage technologies and illustrate the benefits of mixing multiple technologies.

3 - Parallel Power System Simulation using Time Domain Decision Persistence Analysis
Marissa Hummon, National Renewable Energy Laboratory, 15013 Denver West Parkway, Golden, CO, 80401, United States of America, Marissa.Hummon@nrel.gov, Wesley Jones, Paul Denholm, Clayton Barrows, Gregory Brinkman

Production cost models (PCMs) simulate power system operation at hourly (or higher) resolution. While computation times often extend into multiple days, the sequential nature of PCM's makes parallelism difficult. We exploit the persistence of unit commitment decisions to select partition boundaries for simulation horizon decomposition and parallel computation. Partitioned simulations are benchmarked against sequential solutions for optimality and computation time.

4 - Simulation-based Optimization: An Application to Generation Expansion Planning
Mark Rodgers, Rutgers University, Rutgers University, Piscataway, NJ, 08854, United States of America, mdrodgers07@gmail.com, David Coit, Saltuk Selcuklu, Frank Felder

Generation Expansion Planning (GEP) models are least-cost optimization problems. The resulting expansion plans include fossil fuels, which satisfy the load, but produce hazardous emissions. These hazards impose externalities on consumers that are not considered in GEP models. In this work, simulation methods are used to derive these externalities, and various prediction methods are assessed. GEP models are then extended to include these costs in the objective function.

■ TA51

Level 1 -102D

Transportation Planning under Uncertainty

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Chengliang Zhang, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, United States of America, czhang85@gatech.edu

1 - Flexible Solutions to Maritime Inventory Routing Problems with Delivery Time Windows
Chengliang Zhang, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, United States of America, czhang85@gatech.edu, Myun-Seok Cheon, Ahmet Keha, Joel Sokol, George Nemhauser

We study a Maritime Inventory Routing Problem with Time Windows (MIRPTW) with uncertain travel disruptions. The goal is to generate flexible solutions that can withstand these disruptions. We add soft constraints that provide robustness to the solutions. These constraints are dualized and we explore solutions obtained with different multipliers. To evaluate the flexibility of solutions, we use a simulator that generates disruptions and recovery solutions.

2 - Anticipatory Routing of Police Helicopters
Rick van Urk, PhD Candidate, University of Twente, Dep. Industrial Engineering and Business, PO Box 217, Enschede, 7500 AE, Netherlands, r.vanurk@utwente.nl, Martijn Mes, Erwin Hans

We have developed an application for the Dutch Aviation Police for routing their helicopters in anticipation of future incidents that are unknown in advance, yet do require a swift response. We generate a forecast, and use a heuristic to determine the departure times and the routes. The underlying problem is a combination of the Location Covering Problem and the Vehicle Routing Problem. As the simulation results are promising, the Dutch Aviation Police now uses the application in practice.

3 - The Value of Information Accuracy in the Designated Driver Problem
Jordan Srour, Assistant Professor, Lebanese American University, Chouran, Beirut, Lebanon, fjsrour@gmail.com, Niels Agatz, Johan Oppen

We examine a pick-up and drop-off problem in which passengers call for rides home after a night of drinking. In such a problem, customers may pre-announce their job location, but remain uncertain about the timing. We explore the value that this inaccurate time information brings by comparing several hybrid stochastic and dynamic routing strategies.

4 - Value of Information for Managing Inventory and Routing with Expediting
Necati Ertekin, Texas A&M University, 320N Wehner 4217 TAMU, College Station, TX, 77843-4217, United States of America, nertekin@mays.tamu.edu, Michael Ketzenberg, Richard Metters

We consider a stochastic inventory routing problem where a supplier serves multiple customers using a single vehicle. We study the value of inventory level information in integrating and coordinating inventory management and vehicle routing. We formulate a Markov decision process model and propose a heuristic where the key assumptions are that expediting occurs when demand exceeds capacity, expediting affects future routing decisions, and inventory levels are known prior to decision making.

■ TA52

Level 1 -102E

Revenue Management in Transportation

Contributed Session

Chair: Laurie Garrow, Georgia Institute of Technology, 790 Atlantic Drive, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu

1 - Simultaneous Pricing of New and Old Versions of Products
Vinod Cheriyan, Graduate Student, Georgia Tech, Stewart School of Industrial and Systems, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, vinod.cheriyan@gatech.edu, Anton Kleywegt

In the context of consumer electronics industry, we consider the problem of simultaneous pricing of new and old versions of products in the presence of impatient customers. We consider a stylized model in which a monopolist firm offers one new version and one old version of a product in a planning cycle. The customers vary in their impatience with the impatient customers preferring to buy earlier than later, ceteris paribus. We analyze the model and provide comparative statics results.

2 - Demand Learning in the Presence of Strategic Consumers for a Click Tracking Etailer
Shuzhen Sun, Oklahoma State University, 322 Engineering North, Oklahoma State University, Stillwater, OK, 74078, United States of America, shuzhen.sun@okstate.edu, Tieming Liu

Click tracking enables etailers to better forecast the demand and understand consumers'on-line shopping behavior. This paper studied a two-period monopoly model to decide the optimal prices for both periods through online demand learning in the presence of strategic consumers. Numerical analysis shows that the total profit is improved by about 5% compared to the case without demand learning. Further, sensitivity analysis on the initial inventory level and click probability are also conducted.

3 - Bundling Premium and Standard Transportation Modes under Competition

Prakash Mirchandani, University of Pittsburgh, Mervis Hall, Pittsburgh, PA, 15260, United States of America, pmirchan@katz.pitt.edu, Mihai Banciu

Transportation service operators often provide a choice of premium and standard modes of service. We consider a duopolistic, vertical product market with competition, comprised of a "dominant" and a "weaker" firm. We determine the optimal bundling strategies when available transportation capacity is limited, and demonstrate the suboptimality of full-spectrum mixed bundling. We also show that "following the leader" does not work and that the equilibrium depends on the strength of the weaker firm.

4 - Power to the Poor: Electric Grid Connection Pricing in Developing Countries

Michael Beeler, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, beeler@mit.edu, David Simchi-Levi, Cynthia Barnhart

The cost of electricity distribution and transmission infrastructure is a major barrier to rural electrification in developing countries. Power companies often recover these costs through connection fees that impede grid growth and result in sub-optimal network density. We use dynamic programming to identify pricing policies that accelerate electrification while ensuring cost recovery.

5 - Identification of GNL Models for Censored Choice-based Samples

Laurie Garrow, Georgia Institute of Technology, 790 Atlantic Drive, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu, Mark Ferguson, Jeffrey Newman

We derive identification properties for generalized nested logit (GNL) models for cross-sectional choice-based samples in which one or more alternative is completely censored. GNL models include the MNL, NL and other discrete choice models that allow for flexible product substitution patterns. Empirical examples based on simulated datasets demonstrate the large-sample consistency of estimators and provide insights into data requirements needed to estimate these models for finite samples.

■ TA53

Level 1 -102F

Agricultural Supply Chain

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Sandra Eksioglu, Associate Professor, Mississippi State University, PO Box 9542 206 McCain Engineering Bld., MSSTATE, MS, 39762, United States of America, sde47@ise.msstate.edu

1 - Grain Supply Chain Network Design and Logistics Planning for Reducing Post-Harvest Loss

Yun Bai, University of Illinois, Champaign, IL, United States of America, yunbai1@illinois.edu, Seyed Mohammad Nourbakhsh

Post-harvest loss along grain supply chains can be as high as 50% of the total value including both quality and quantity loss. The preprocessing stage and time delay during transportation and storage largely affect grain degradation. We develop a supply chain design model with multi-modal logistics, facility location, and infrastructure expansion decisions for a regional agriculture system in Brazil. Post-harvest loss is incorporated as a value discount through quality deterioration trajectory.

2 - Consolidation Policies for the Shipping of Perishable Products

Christine Nguyen, nguyen7@usc.edu, Maged Dessouky, Alejandro Toriello

We study an agricultural supply chain where several suppliers consolidate their products to save transportation costs. In the deterministic case, we compare a one-period look-ahead heuristic against optimal solutions computed from a dynamic program. We show how the look-ahead policy performs against other simple policies and demonstrate the effectiveness of a cost allocation rule in the stochastic demand environment.

3 - Algorithms for Multi Mode Economic Lot Sizing Models for Perishable Products with Carbon Emissions

Gokce Palak, Mississippi State University, PO Box 9542, Mississippi State, MS, 39762, United States of America, gp192@msstate.edu, Joseph Geunes, Sandra Eksioglu

We extend economic lot sizing models for age dependent perishable products to minimize costs and carbon emissions. Using a multiple setups cost structure for transportation, we propose algorithms to solve cost-minimization models where one, two or multiple modes of transportation are available. We also develop a lagrangean relaxation based heuristic solve the models under carbon emission considerations.

■ TA54

Level 1 -103A

Panel Discussion: How to Make Professional Presentations

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Xuegang Ban, Assistant Professor, Rensselaer Polytechnic Institute, Troy, NY, United States of America, banx@rpi.edu

1 - How to Make Professional Presentations

Moderator: Xuegang Ban, Assistant Professor, Rensselaer Polytechnic Institute, Troy, NY, United States of America, banx@rpi.edu, Panelists: Yingyan Lou, Srinivas Peeta, Stephen Boyles

This panel discussion session aims to help young professionals including graduate students, post-doctoral researchers, and junior faculty member to improve their presentation skills. The panelists will share their own experiences and "tips" on how to make the best professional presentations. This will be followed by Q/A. Live discussions are expected among the panelists, and between the panel and the audience.

■ TA55

Level 1 -103B

Traffic Assignment and Applications

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Hong Zheng, University of Arizona, Tucson, United States of America, hzheng@email.arizona.edu

1 - A Simulation-based Optimization Algorithm for Dynamic Urban Transportation Problems

Carolina Osorio, Massachusetts Institute of Technology, Cambridge, MA, United States of America, sorioc@mit.edu, Linsen Chong

We present a simulation-based optimization (SO) algorithm to address continuous generally constrained dynamic urban transportation problems. The algorithm is based on a metamodel that combines performance estimates from a stochastic traffic simulator with those from a macroscopic traffic model.

2 - A Link Based Dynamic Network Loading Model

Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, Feng Zhu

This study develops a new link based dynamic network loading model which is efficient in large scale simulation and readily applicable for analytical analysis. Shockwave propagation is well captured by checking the difference of queue forming and dissipation end. A small numerical example is compared with Cell Transmission Model and Point Queue model, confirming the model? accuracy in travel time estimation. Two more tests are conducted on a hypothetical network and the Manhattan network, confirming the model? efficiency in large scale network simulation.

3 - Network Simplex for the Traffic Assignment Problem

Hong Zheng, University of Arizona, Tucson, United States of America, hzheng@email.arizona.edu

We present a network-simplex-like algorithm for the static traffic assignment problem. We show the algorithm can produce high precise solution with fast convergence on large-scale networks.

4 - Cost Scaling for the Traffic Assignment by Successive Approximation

Hong Zheng, University of Arizona, Tucson, United States of America, hzheng@email.arizona.edu, Srinivas Peeta

We present a successive approximation algorithm to solve the traffic assignment problem. Restricted master problem is solved to e-optimality before bush reconstruction. We show the algorithm can solve a highly precision solution on a large-scale network with much less computational effort than a generic bush algorithm.

■ TA56

Level 1 -103C

Introducing Renewables and Demand Side into Complex Power System Models

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Pedro Linares, Associate Professor, Comillas P. University, Alberto Aguilera 25, Madrid, 28015, Spain, pedro.linares@upcomillas.es

1 - CGE, Bottom-up Electricity and Hybrid Models – Strengths and Weaknesses Compared for the Same Policy

Renato Dias B. Rodrigues, Research Assistant, IIT - Instituto de Investigaciòn Tecnològica - Madrid - Spain, calle Santa Cruz de Marcenado, 26, Madrid, 28015, Spain, renato.rodrigues@iit.upcomillas.es, Pedro Linares

The importance of energy and environmental policy assessments requires a detailed consideration of which modeling instrument is better suited for the task. This work presents the results obtained from a traditional CGE, a time and technological disaggregated CGE, a bottom-up electricity and a hybrid modeling alternative face to face in order to underline the strengths and caveats of each of the most common modeling framework alternatives in the energy-environmental policy evaluations.

2 - Modeling Large-scale Penetration of Renewable Energy in the MIT EPPA Model: A Decomposition Approach

Claudia Octaviano, Research Associate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E19-411, Cambridge, MA, 02139, Mexico, claus@mit.edu, Mort Webster, Jose Ignacio Perez-Arriaga

A generation capacity expansion model, which includes the main constraints for a reliable and secure operation of power systems, as well as demand, wind and solar resources at the hourly time-scale, and a simplified transmission formulation, is coupled to the MIT EPPA model, a recursive-dynamic multi-regional general equilibrium model of the world economy for climate change policy analysis. We use Boehringer and Rutherford's decomposition algorithm, and Mexico as a case study.

3 - Modeling Power Systems with a High Penetration of Renewables

Sonja Wogrin, IIT, Comillas Pontifical University, Madrid, Spain, sonja.wogrin@iit.upcomillas.es, Andrés Delgadillo, Javier Reneses, Pablo Dueñas

We propose a new modeling approach to address the challenges that arise in power systems with a high penetration of renewable energy sources by introducing system states instead of traditional load periods. This allows us to represent important operational details such as start-up and shut- down decisions in medium- or long-term models thereby overcoming the lack of chronological information predominant in current models.

4 - Optimal Replacement of Wind Turbines under Uncertainty: A Multiple Lag Real Options Approach

Michail Chronopoulos, Norwegian School of Economics, Oslo, Norway, Michail.Chronopoulos@nhh.no, Afzal S. Siddiqui, Johannes Mauritzen

We address the problem of optimal replacement of wind turbines taking into account electricity price as well as technological uncertainty. By casting this problem as a real options problem with multiple lagged investments, we illustrate not only how policy uncertainty impacts the optimal timing of wind turbine replacement, but also how it affects the type of wind turbines being replaced by allowing policy uncertainty to be endogenously related to technological innovation.

■ TA57

Level 1 -103D

Energy Modeling

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Parviz Darvish, ESSEC Business School, 1, Ave. Bernard Hirsch, Cergy, 95000, France, Parviz.darvish@essec.edu

1 - Pakistan Energy Crisis — Breaking the Vicious Cycle

Raza Rafique, PhD Student, Rutgers Unviersity, 1 Washington Park, Newark, NJ, 07102, United States of America, rrafique@pegasus.rutgers.edu, Yao Zhao, Kwon Gi Mun

In recent years, Pakistan suffers a 25-40% shortfall of electricity supply nation-wide which hampers the economic growth, and give rise to political turmoils and social instability. Meanwhile, Pakistan has a huge reserve of coal nearly un-explored. We build a dynamic model to establish the energy supply chain based on coal and compare the result with the government's current plan.

2 - A Method for Computing Optimal Set-point Schedules for HVAC Systems

Jingyang Xu, The Walt Disney Company, 1375 Buena Vista Dr., Orlando, United States of America, jxu7@buffalo.edu, Daniel Nikovski, Mio Nonaka

We propose a method for model-based control of building air conditioning systems that minimizes energy costs while maintaining occupant comfort. The method uses a building thermal model in the form of a thermal circuit identified from collected sensor data, and reduces the building thermal dynamics to a Markov decision process (MDP) whose decision variables are the sequence of temperature set-points over a suitable horizon.

3 - A Bi-level Stochastic Programming for Natural Gas Market Network Based on EPEC Methodology

Parviz Darvish, ESSEC Business School, 1, Ave. Bernard Hirsch, Cergy, 95000, France, Parviz.darvish@essec.edu

In this presentation, we consider a natural gas market network with five tiers of players and propose a bi-level stochastic programming in terms of equilibrium problem with equilibrium constraint (EPEC) methodology to attain an equilibrium condition. The model tries to find out both optimal primal and dual decision variables of Cournot competitors regarding the agents'profit maximization and loss risk minimization.

■ TA58

Level 1 -103E

Algorithms for the Smart Grid

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Miguel F. Anjos, Canada Research Chair, Ecole Polytechnique de Montreal, C.P. 6079, Succ. Centre-Ville, Montreal, QC, H3C 3A7, Canada, miguel-f.anjos@polymtl.ca

1 - Smart Grid and Operation of the Power System

Guillermo Bautista, Manager, Market Validation and Quality, California ISO, 250 Outcropping Way, Folsom, CA, 95630, United States of America, bautista.guillermo@gmail.com

With emerging technologies, the traditional paradigm of operating and controlling the power system is evolving towards identifying and reacting to grid events much faster and accurately. In this presentations, several aspect of smart grid will be introduced, including tools to manage more efficiently the power grid, two-way communications, consumer-response curtailments such as demand response and smarter forecasting.

2 - Long-Term Capacity Expansion with Endogenous Real-Time Pricing and Demand Response

Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47906, United States of America, andrewliu@purdue.edu, Jingjie Xiao

We present a multiscale modeling framework, based on approximate dynamic programming, that combines long-term capacity expansion and short-term operation of an electric power grid. In the short-term, real-time retail pricing (RTP) is integrated with the grid-level economic dispatch, and demand response (DR) is realized through smart-grid-aided control automation. We will present numerical results to show the impacts of RTP and Dr. on capacity mix, economic surplus, and system-level emissions.

3 - Stochastic Optimization and Robust Ancillary Services Determination for Electricity System Operation

Alberto Lamadrid, Assistant Professor, Lehigh University, 621 Taylor Street, room 451, Bethlehem, PA, 18015, United States of America, ajlamadrid@lehigh.edu, Tim Mount, Ray Zimmerman, Carlos Murillo-Sanchez

This paper formulates a receding horizon framework, for System Operators in their daily operations, in the context of high penetration of renewable energy sources (RES). The model has an electricity network system operator seeking to maximize the welfare of consumers and producers, procuring energy and ancillary services in a robust manner using a security constrained Optimal Power Flow (SC-OPF).

4 - Modeling and Solutions for Seasonal Transmission Switching

Masood Jabarnejad, PhD Student, Auburn University, 333 East Magnolia Ave., Cavell Court, Unit 44, Auburn, AL, 36830, United States of America, mzj0008@auburn.edu, Jianhui Wang, Jorge Valenzuela

Recently, optimal transmission switching is proposed for cost reduction in the power generation and dispatch. Contemporary transmission infrastructure favors the infrequent periodic switching. We propose seasonal transmission switching (STS) to meet power demands and N-1 reliability requirements throughout a season and to manage technological limitations in transmission systems, while providing cost savings. To this end, we develop a decomposition algorithm to solve the STS problem efficiently.

5 - Hierarchical Demand Response Bidding Framework in Wholesale Energy Markets

Masood Parvania, Sharif University of Technology, Electrcical Engineering Department, Azadi Ave., Tehran, Iran, parvania@gmail.com, Mahmud Fotuhi-Firuzabad

This presentation introduces a hierarchical Dr. bidding framework in wholesale energy markets. In the proposed framework, Dr. aggregators actively correspond with ISO and customers for maximizing DR. The Dr. aggregators utilize the proposed price-based self-scheduling model to optimize the Dr. offers. The ISO clears the day-ahead energy market considering energy offers of generating units and load reduction offers of Dr. aggregators. The ISO's and aggregators' models are formulated as MILP problems.

■ TA59

Level 1 -103F

New Methods in Sustainable Production and Transportation

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Ying Wang, Associate Professor, Beihang University, 37 Xueyuan Road, Haidian District, New Main Building H1101, Beijing, 100191, China, yingwang@buaa.edu.cn

1 - A Sustainable Model for Optimal Dynamic Allocation of Tug Boats to Oil Tankers

Brice Assimizele, PhD Student, Aalesund University College, Hus 201 Nørvegjerdet 2A, lesund, No, 6009, Norway, bras@hials.no, Johannes O. Røyset, Johan Oppen

The Norwegian Coastal Administration administers a number of vessel traffic services (VTS) centers along the Norwegian coast, one of which is located in the extreme northeast part of Norway. The task of the operators at the VTS center in Vard ̈ is to command a fleet of tug vessels patrolling the northern Norwegian coastline such that the risk of oil tanker drifting accidents is reduced. We propose a mix integer programming model to address the problem.

2 - Hybrid Genetic Algorithm to Coordinate Production and Transportation in Coal Mines

Jiu Song, Xi'an Jiaotong University, Xi'an, Shaanxi, 710049, P.R. China, Xi'an, China, jeroldsong@gmail.com, Zhili Zhou

The coal production mainly consists of three stages in which various equipment need maintenance each day. The finished products will be transported by trains. The objective is to minimize the shutdown times of equipment and aversion to maintenance time considering multiple coal mines. We first develop a mixed integer linear programming model and then a hybrid genetic algorithm is proposed to solve it. Computational results show that our algorithm can produce good-quality solutions efficiently.

3 - Quality Decisions in Sustainable Manufacturing

Farhad Azadivar, Professor, University of Massachusetts Dartmouth, 40 William Street, South Dartmouth, MA, 02748, United States of America, fazadivar@umassd.edu

A solution is presented to decide on the optimum quality when products are replaced with new ones and returned products are recycled. The paper explores the tradeoff between the costs of the targeted quality versus the additional cost of remanufacturing using returned parts.

4 - Smartphone Application: A New Tool for Individual Drivers to Contribute to Sustainability

Ying Wang, Associate Professor, Beihang University, 37 Xueyuan Road, Haidian District, New Main Building H1101, Beijing, 100191, China, yingwang@buaa.edu.cn

Smartphone applications have been developed very functional and used worldwide in recent years. Result from our questionnaire survey shows that many Chinese drivers select to use navigation apps on their smartphone rather than traditional portable GPS or the in-vehicle embedded GPS while driving. It suggests to develop novel smartphone applications as a new solution to promote sustainability in the transportation system.

■ TA60

Mezzanine - 100A

Data Mining Applications II

Sponsor: Data Mining

Sponsored Session

Chair: Gianluca Gazzola, PhD Student, Rutgers University, Piscataway, NJ, 08854, United States of America, ggazzola@rci.rutgers.edu

1 - Incident Ticket Analysis for an IT Services Business: A Case Study

Ta-Hsin Li, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, thl@us.ibm.com, Ying Li, Rong Liu, Jeaha Yang, Juhnyoung Lee

We provide a case study to demonstrate the values of incident ticket analysis for a type of IT services that supports application implementation, application help desk, application maintenance and support, and application monitoring. An incident ticket is a record of services for dealing with failures, errors, or any troubles with an application. Goals of ticket analysis include assessment of the quality of service, assessment of workload, and identification of root causes.

2 - Scheduling Power Generation of a Wind Farm Based on Data-driven Models

Zijun Zhang, Assistant Professor, City University of Hong Kong, Rm P6600, 6/F, Academic 1, 83 Tat Chee Avenue, Hong Kong, Hong Kong - PRC, zijzhang@cityu.edu.hk, Andrew Kusiak

Scheduling a wind farm in the presence of uncertain wind speed conditions is studied.Scheduling models are constructed by incorporating mathematical programming and data mining.A migrated particle swarm optimization algorithm is developed to solve the scheduling models.Insights into the operation of wind farms are discovered.

3 - Stock Index Forecasting Based on an EMD-based Hybrid Model

Youqin Pan, Assistant Professor, Salem State University, 352 Lafayette Street, Salem MA 01945, United States of America, youqinpan@my.unt.edu

A novel forecasting model based on empirical mode decomposition(EMD) is proposed to predict stock market index. The proposed method first use EMD to adaptively decompose the complicated stock index into a small number of intrinsic mode functions(IMFs) and a residue. Then, hybrid models integrating EMD and Neural Networks Models were employed to predict the stock index.

■ TA61

Mezzanine - 100B

Data Mining in Medical and Business Domain

Sponsor: Data Mining

Sponsored Session

Chair: Lian Duan, New Jersey Institute of Technology, Department of Information Systems, Newark, NJ, 07102, United States of America, duanlian.cn@gmail.com

1 - Mining Electronic Medical Records for Adverse Drug Reactions

Mei Liu, Assistant Professor, New Jersey Institute of Technology, University Heights, Newark, NJ, 07102, United States of America, mei.liu@njit.edu, Eugenia McPeek Hinz, Michael Matheny, Hua Xu, Joshua Denny, Randolph Miller, Jonathan Schildcrout

Drugs are important part of today's medicine, but may cause adverse drug reactions (ADRs). Severe ADRs are estimated to cause over 100,000 fatalities in the US each year. This study examines the use of retrospective medication orders and inpatient laboratory results documented in the Electronic Medical Record (EMR) to identify ADRs. It correlated abnormal laboratory results with specific drug administrations by comparing the outcomes of a drug-exposed group and a matched unexposed group.

2 - Integrative Approach for Intelligent Software Project Risk Management: From Analysis to Planning

Yong Hu, Professor, Guangdong University of Foreign Studies, School of Business, Guangzhou, China, henryhu200211@163.com, E.W.T. Ngai, Ming Fan, Mei Liu, Jianfeng Du, Xiangzhou Zhang, Xiaoling Hao

Software projects have inherent risks that are too complex and difficult to manage effectively through subjective judgment. For the first time, this study proposes an integrative framework for intelligent software project risk planning system to produce a cost-minimal action set for risk control based on the risk analysis module. To integrate complex risk factors, risk analysis knowledge and planning actions, a novel many-to-many actionable knowledge discovery (MMAKD) method has been proposed.

3 - Optimize Treatment Outcome through Personalized Health Management

Chih-Lin Chi, University of Minnesota, Minneapolis, MN, United States of America, chihlin.chi@gmail.com

Studying patterns among patient characteristics, treatment options, and outcomes enable optimizing treatment options and outcome based on patients' characteristics. We will discuss a two-step approach to speed the implementation of personalized care in a clinical setting: (1) discovering the pattern and evidence from medical data, and (2) producing transparent clinical rules which can thereafter be confirmed by clinical experts and for which clinical trials can be executed to test the results.

■ TA62

Mezzanine - 100C

Image and Functional Data Analysis; Methods and Applications I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, Atlanta, GA, United States of America, kamran.paynabar@isye.gatech.edu

1 - Introduction to Some Image Processing Problems

Peihua Qiu, Professor, University of Minnesota, Minneapolis, MN, United States of America, qiuxx008@umn.edu

Image data becomes more and more popular. In this talk, I will introduce some basic image processing problems, including edge and feature detection, and image registration, that are essential for statistical monitoring of image data. I will also describe the related statistical methods for handling these image processing problems based on jump regression analysis.

2 - Machining System Design, Analysis, and Monitoring via Process Data Point Clouds

Jaime Camelio, Associate Professor, Virginia Tech, 235 Durham Hall, Virginia Tech, Blacksburg, VA, 24061, United States of America, jcamelio@vt.edu, Mohammed Shafae, Lee Wells

New technologies has allowed for the recording of large data sets in machining, from forces to acoustic emissions. While the use of such data has been an active research area, the problem is usually considered a time-series analysis. What tends to be missing is the relationship between the time-series and the physical dimensions. This talk discusses the concept of performing a dimensional transformation of machining data into point cloud data for tool life prediction and process monitoring.

3 - Wavelet ANOVA for Detection of Local and Global Profile Changes

Eric Chicken, Associate Professor, Florida State University, 117 N. Woodward Ave., PO Box 3064330, Tallahassee, FL, 32306-4330, United States of America, chicken@stat.fsu.edu, Sentil Girimurugan, Jinfeng Zhang

Statistical functional data analysis has gained much attention recently due to significant increases in the volume of data collected. We extend previous high dimensional methods to a generalized functional ANOVA method in the wavelet domain. We show that our statistic has improved power in detecting differences of small magnitudes due to the incorporation of dimension reduction via wavelet thresholding. Our method is evaluated via simulation and on real industrial and genetic data sets.

4 - A Sensor-fusion based Methodology for Real-time System Prognostics

Kamran Paynabar, Georgia Institute of Technology, Atlanta, GA, United States of America, kamran.paynabar@isye.gatech.edu, Nagi Gebraeel, Xiaolei Fang

The availability of sensor technology has facilitated the capability of monitoring systems degradation. In this research, we develop a multi-sensor prognostic methodology to dynamically estimate residual lifetime (RL) of partially degraded systems. First, a regularized functional regression model is developed to identify sensors whose signals are correlated with degradation processes. These signals are then fused via multi-dimensional functional PCA that is used to predict the RL of a system.

■ TA63

Mezzanine - 100D

Condition-based Maintenance Optimization

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hao Peng, Assistant Professor, Eindhoven University of Technology, PO Box 513, Eindhoven, 5600MB, Netherlands, h.peng@tue.nl

1 - Accelerated Burn-in and Condition-based Maintenance for N-subpopulations Subject to Stochastic Degradation

Yisha Xiang, Sun Yat-Sen University, Guangzhou, China, xiangysh@mail.sysu.edu.cn, David Coit, Qianmei Feng

For some manufacturing applications, populations of manufactured components can consist of several sub-populations. A new model is developed to determine accelerated burn-in and condition-based maintenance policies for heterogeneous populations. We also compare the proposed joint accelerated burn-in and condition-based maintenance policy with two benchmark policies. Sensitivity analysis is performed to investigate the value of joint accelerated burn-in and condition-based maintenance policy.

2 - An Opportunistic Maintenance Policy for Components in Complex Systems under Condition Monitoring

Qiushi Zhu, Eindhoven University of Technology, De Lismortel, Paviljoen E.14, Eindhoven, 5600 MB, Netherlands, q.zhu@tue.nl, Hao Peng, Geert-Jan van Houtum

Due to the advanced sensor technologies nowadays, we can continuously monitor the degradation of critical components in complex systems to prevent the unexpected failures by condition-based maintenance (CBM) policies. How to coordinate different maintenance actions in the system becomes a challenging problem. We propose a new optimization model to determine the control limits of opportunistic maintenance for monitored components. Moreover, a case study in semiconductor industry is provided.

3 - Condition Based Maintenance Optimization Considering Improving Prediction Accuracy

Zhigang Tian, tian@ciise.concordia.ca, Bairong Wu

In condition based maintenance (CBM), component health condition is predicted using condition monitoring data. It is observed that the prediction accuracy improves with the increase of the age of the component. In this research, we develop a method to quantify the remaining life prediction uncertainty considering the prediction accuracy improvements, and an effective CBM optimization approach to optimize the maintenance schedule.

■ TA64

Mezzanine - 100E

Decision-Making & E-Retailing

Sponsor: Information Systems

Sponsored Session

Chair: Howard Hao-Chun Chuang, Assistant Professor, National Chengchi University, Dept. of Management Information Systems, No.64, Sec. 2, Zhinan Rd., Wenshan Dist., Taipei, 11605, Taiwan - ROC, hchuang@mis.nccu.edu.tw

1 - Assessing Information Functions of Mobile Retailers: A Zero-truncated Conway-Maxwell Poisson Regression Model

Yen-Chun Chou, Assistant Professor, National Chengchi University, No 64 Sec 2 Zhinan Rd., Wenshan District, Taipei, 11605, Taiwan - ROC, yenchunchou.mis@gmail.com, Howard Hao-Chun Chuang

Our paper presents an empirical analysis of e-retailers' adoption of information functions in mobile retailing. In our attempt to analyze the collected data, we find that the count of information functions exhibits zero-truncation and under-dispersion. To address the two issues, we use a zero-truncated Conway-Maxwell Poisson regression model and find that ignoring under-dispersion not only compromises model fit but also delivers misleading results.

2 - Restocking: A Stitch in Time Saves Nine?

Bo Li, Doctoral Student, Texas A&M University, 320M Wehner Bldg, College Station, TX, 77843, United States of America, bli@mays.tamu.edu, Rogelio Oliva

We examine how store manager actions (reactive activity and preventive activity) link to system/store performance in the inventory replenishment of a retail chain. We find that manager actions improve final performance and that reactive activity mediates the relationship between system performance and final performance. We also find that preventive activity are preferred to reactive activity due to workload constraint. Store managers are thus advised to intervene in the restocking decisions.

3 - The Moderating Roles of Types of Recommender Systems and Products on Recommender System Acceptance

Yen-Yao Wang, Doctoral Student, Michigan State University, North Business College Complex, 632 Bogue St. N270, East Lansing, United States of America, wangyen@bus.msu.edu, Anthony Townsend, Andy Luse, Brian Mennecke

This study investigates how consumers assess the quality of two types of recommender systems and also considers hedonic and utilitarian product characteristics on this issue. This study utilized a 2x2 crossover within-subjects experimental design involving a total of 80 participants. The results suggested that the type of recommender system significantly impacted many of relationships on behavioral intention. Surprisingly, the type of product did not impact relationships on behavioral intention.

4 - The Impact of Operational Conditions on Efficiency Frontier of e-Retailers

Howard Hao-Chun Chuang, Assistant Professor, National Chengchi University, Dept. of Management Information Systems, No.64, Sec. 2, Zhinan Rd., Wenshan Dist., Taipei, 11605, Taiwan - ROC, hchuang@mis.nccu.edu.tw, Yen-Chun Chou, Gregory Heim, Rogelio Oliva

We take a frontier modeling approach to assess the impact of operational conditions on e-retailer performance. Methodological issues regarding data envelopment analysis and stochastic frontier analysis are discussed. We tackle those issues using the convex non-parametric least square and analyze the effects of different contextual factors on efficiency frontier. Finally, we propose a Bayesian approach to derive efficiency estimates under flexible moment conditions.

■ TA65

Mezzanine - 100F

Miscellaneous Networks Analyzed

Cluster: Social Media Analysis

Invited Session

Chair: Donald P. Gaver, Professor Emeritus of Operations Research, Naval Postgraduate School, Monterey, CA, United States of America, dgaver@nps.org

1 - The Impact of Application Spawning in the Internet on Network Neutrality

Qiong Wang, Associate Professor, Industrial and Enterprise System Engineering, University of Illnois at Urbana-Champaign, United States of America, qwang04@illinois.edu, Debasis Mitra

The Internet provides a networked platform to support the spawning of new applications. Revenues from such applications induce a network provider to keep the spawning process viable when making resource allocation decisions. We model this phenomenon and draw inferences of interest in the network neutrality debate. We show that the spawning process counters a provider's incentive to abuse its monopoly power in offering a metered premium service and a subscription-based best-effort service.

2 - Tweet the Revolution, Information is Power

Rob Schroeder, Naval Postgraduate School, Monterey, CA, United States of America, rcschroe@nps.edu

Twitter is a place where users are able to post and send short messages about any topic they like, with most messages pertaining to news events. This paper analyzes the network of Twitter conversations during the Egyptian Revolution in 2012 as well as recent conversations about Syria. It focuses on the content being passed around in order to analyze which accounts have the most social capital by bridging structural holes of information in the network.

3 - Small Worlds by Design

Donald P. Gaver, Professor Emeritus of Operations Research, Naval Postgraduate School, Monterey, CA, United States of America, dgaver@nps.org, Patricia Jacobs

A large group (size n) of entities is to be linked together efficiently. Forming optimal subgroups, size O(n^(1/3)) each with one representative, and representatives in higher subgroup, total connections is O(n^(4/3)) so efficiency of two levels over one is O(n^(2/3)). Further efficiency can be achieved.

4 - Fundamental Properties of Linear Loss Social Networks

Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, mss@us.ibm.com, Peter Momcilovic

We investigate theoretical properties of a canonical form of linear loss social networks for which maximum throughput is derived and the optimal arrival process is established. An asymptotically critical loading regime is identified such that the probability of an arbitrary loss is strictly within (0,1), delivering throughput comparable to the maximum at a low network cost.

■ TA66

Mezzanine - 100G

IT Governance, Distribution and Licensing

Sponsor: Information Systems

Sponsored Session

Chair: Terrence August, University of California-San Diego, 9500 Gilman Drive MC 0553, Otterson Hall 3S-146, La Jolla, CA, 92093-0553, United States of America, taugust@ucsd.edu

1 - Impact of Technology Clusters on Centralization of IT Governance

Taha Havakhor, University of Arkansas, Sam M. Walton College of Business, Fayetteville, AR, United States of America, THavakhor@walton.uark.edu, Mohammad Rahman, Pankaj Setia

Choice of IT governance mode–centralized or decentralized–is an important decision facing firms. We argue that a firm's choice is dependent on the technology clusters across different organizational sites. We empirically assess how similarities in software and hardware assets across sites lead to centralization of IT governance. In addition, we show how relative size of the site with the respect to its organizational headquarters moderates the effects of technology clustering on IT governance.

2 - Optimal Timing of Sequential Distribution: The Impact of Congestion and Day-and-Date Strategies

Duy Dao, University of California-San Diego, Rady School of Management, San Diego, CA, United States of America, duy.dao@rady.ucsd.edu, Terrence August, Hyoduk Shin

The window between a film's theatrical and video releases has been declining with some studios now testing day-and-date strategy (releasing different versions simultaneously). We study the optimal video release timing and the video pricing strategies for studios. We present a consumer choice model that examines trade-offs between substitutable products (theatrical and video formats), the possibility of purchasing both alternatives, and a congestion externality affecting consumption at theaters.

3 - The Impact of Licensing on Open Source and Proprietary Software Competition

Wei Chen, University of California-San Diego, Rady School of Management, San Diego, CA, United States of America, Wei.Chen@rady.ucsd.edu, Terrence August, Kevin Zhu

Open source licensing is an important device that coordinates the co-creation of open source software. This paper studies how the restrictiveness of an open source license affects both an open source originator's and subsequent contributor's development incentives when a strong proprietary vendor competes in the same market. We characterize how the aggregate impact of license restrictiveness is influenced by competitive forces.

■ TA67

Mezzanine - 100H

Decision Making in Interdependent Systems

Sponsor: Decision Analysis

Sponsored Session

Chair: Kash Barker, Assistant Professor, University of Oklahoma, 202 West Boyd, Room 124, Norman, OK, 73019, United States of America, kashbarker@ou.edu

1 - Interdependent Impacts in Infrastructure Resilience Modeling

Hiba Baroud, PhD Student, University of Oklahoma, 202 West Boyd St., Rm. 124, Norman, OK, 73019, United States of America, hbaroud@ou.edu, Kash Barker, Jose Emmanuel Ramirez-Marquez, Claudio Rocco

A resilience modeling approach is developed with a focus on the inherent costs of a disruptive event. This work integrates the quantitative resilience approach with a model describing the regional, multi-industry impacts of a disruptive event, thereby measuring the positive impact of resilience. A case study of an inland waterway transportation network, the Mississippi River Navigation System, illustrates the approach discussed.

2 - Resilience Building Lessons from Super-storm Sandy

Jose Emmanuel Ramirez-Marquez, Director, Stevens Institute of Technology, 1 Castle Point Terrace, Hoboken, NJ, United States of America, jmarquez@stevens.edu, Qing Li

Supper-storm sandy impacted New Jersey early on October 29th severely affecting the state for the following weeks. Throughout the state electric power outages affected the population. In this study, we have compiled data of outages per day to develop resilience curves associated to the response by county. based on these resilience graphics, we present a vulnerability reduction approach that accounts for the economic impact of power outages.

3 - Interdependent Vulnerability Analysis of Multi-commodity Transportation Networks

Mohamad Darayi, PhD Student, University of Oklahoma, 202 W. Boyd St., Room 435, Norman, OK, 73019, United States of America, Mohamad.Darayi-1@ou.edu, Kash Barker

The vital role that the freight network plays in transporting raw materials and final products between manufacturing and consumption centers highlights its position in the economy. This network is susceptible to disruptions which result in some nodes or links becoming inactive. This research studies the vulnerability of a multi-commodity freight transportation network in the context of economic interdependency impact, integrating network flow techniques with inoperability input-output model.

4 - Characterizing Nonlinearities in Interdependent Network Resilience

Christopher Zobel, Virginia Tech, 1007 Pamplin Hall, Blacksburg, VA, 24061, United States of America, czobel@vt.edu

The complexity of the interactions between different components of interconnected systems will typically lead to nonlinear recovery profiles following a network disruption. This non-linearity may manifest itself in different ways, however, with different levels of efficiency being represented by different characteristic curves. In this paper, we consider such differences with respect to their ability to reflect interdependent behavior in a network after a disrupting event has occurred.

■ TA68

Mezzanine - 100I

Operations and Supply Chain Management

Sponsor: Decision Analysis

Sponsored Session

Chair: Barry Cobb, Virginia Military Institute, 334 Scott Shipp Hall, Economics and Business, Lexington, VA, 24450, United States of America, cobbbr@vmi.edu

1 - Performance Characteristics of Flowshops with Work Flow Control

Steven Harrod, Assistant Professor, University of Dayton, 1143 Ashburton Dr., Dayton, OH, 45459, United States of America, a2soft@aol.com

Very often the terms "pull" and "make to order" are conflated and treated as synonymous. In this presentation we emphasize how this conflation is inaccurate, and by example demonstrate how important it is to describe the distinct combinations of push/pull and make to order/make to stock. Best practices are summarized by these combinations.

2 - Decision Support for Reducing Consumption in Self-sustaining Supply Chains

Jay Simon, Naval Postgraduate School, 699 Dyer Rd., Monterey, CA, United States of America, jrsimon@nps.edu, Eva Regnier

In remote or disaster-impacted regions, resources consumed at intermediate stages of a supply chain may not be locally available, and must therefore be supplied via the chain itself. We refer to such supply chains as "self-sustaining." Self-sustaining supply chains (SSSCs) consume significantly greater quantities of resources than traditional supply chains. We apply mathematical models of SSSC consumption to decision support for alternatives to reduce overall requirements and cost.

3 - Quantifying and Modeling Risks of Food Imports

Vicki Bier, University of Wisconsin-Madison, 1513 University Avenue, Room 3270A, Madison, WI, 53706, United States of America, bier@engr.wisc.edu, Jonathan Welburn, Steven Hoerning

We quantify risks in imported foods using data on food import violations from the FDA. We find that the rate of import violations per volume is a useful indicator of import risk. Furthermore, we model food import risk as a function of country of origin, product type, and key economic indicators using regression analysis. The results elucidate both product & country risks, and indicate that import risk is significantly related to both product type and economic status of the country of origin.

4 - Accurate Lead Time Demand Modeling in Coordinated Supply Chains

Barry Cobb, Virginia Military Institute, 334 Scott Shipp Hall, Economics and Business, Lexington, VA, 24450, United States of America, cobbbr@vmi.edu, Alan Johnson

Under uncertain demand, a mixture distribution approach can be used to model lead time demand in a two-level supply chain. Using this technique, incentives that allow the members to divide the cost savings resulting from coordinating their inventory policies can be determined without assuming normally distributed demand.

■ TA69

Mezzanine - 100J

Marketing I: Interaction Quality and Relationship

Contributed Session

Chair: Basak Manders, PhD Candidate, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, BManders@rsm.nl

1 - Study on the Relationship between Hospital Service Quality and Patient Satisfaction

Jing Sun, Associate Professor, Tsinghua University, Haidian District, Beijing, China, sunj3@sem.tsinghua.edu.cn, Xin LIU

Do survey on pregnant women in maternity specific hospital and gastroenterology patients in comprehensive hospital in Dalian, China. Patients answered questions related to healthcare service quality measures (28 items), and satisfaction (4 items). Attention should be paid on environment and facility in China. Compare with service quality dimensions influencing patient satisfaction between different departments.

2 - IT Capability, Interfirm Relationship Quality and Channel Cooperation

Miao Li, PhD Candidate, Xi'an Jiaotong University, School of Management, No.28, Xianning West Road, Xi'an, 710049, China, 1852415767@qq.com, Guijun Zhuang, Tao Zhang

In this study, we investigate the role of IT capability in the relation between interfirm relationship quality and channel cooperation (joint planning and joint problem solving). We find that: (a) interfirm relationship quality has positive impact on channel cooperation, (2) IT capability has positive impact on joint planning, but no impact on joint problem solving. (3) interfirm relationship quality and IT capability interact with each other in promoting channel cooperation.

3 - Platform Quality in Two-sided Market Competition

Dawoon Jung, Korea University, #517 Main Big. of Business School, Anam-no, Sungbuk-Gu, Seoul, 136-701, Korea, Republic of, bogsil@korea.ac.kr, Myungsub Park, Byung Cho Kim

The quality of platform is very important factor which can decide the number of customers in platform competition. Unfortunately, however, former studies' concerns were focused on network effect caused by the number of platform participants, pricing or service bundling rather than how well the platform works its function, the quality itself. We examine various changes in platform competition considering this quality issue.

■ TA70

Mezzanine -101A

Supply Chain and Logistics

Sponsor: Aviation Applications

Sponsored Session

Chair: Aman Gupta, Assistant Professor, Embry-Riddle Aeronautical University - Worldwide, 600 South Clyde Morris Boulevard, Daytona Beach, FL, 32114, United States of America, guptaa7@erau.edu

1 - The Effect of Website Search Tools on Airline Customers' Purchase Behaviors

Susan Hotle, Georgia Institute of Technology, Atlanta, GA, United States of America, shotle3@gatech.edu, Laurie Garrow, Matthew Higgins

Website search tools that return prices over multiple departure and return dates help consumers find low fares and can enable customers to shift their travel dates. We hypothesize that these search tools result in demand shifts around advance purchase deadlines. In this study, we use search and purchase data from a single OTA to quantify the level of consumer surplus generated by these website search tools. Results show that there is a significant shift in demand due to the presence of advance purchase deadline. We measure consumer surplus using instrumented variable regressions, which control for endogeneity between supply and demand.

2 - Flexible, Analytical Modeling of Airport Security Checkpoints

Nicholas Lownes, University of Connecticut, 261 Glenbrook Rd., U-3037, Storrs, CT, 06269, United States of America, nlownes@engr.uconn.edu, Swapna Gokhale, Derek Doran

Aviation security checkpoints ensure the safety of air travel, yet they are a major source of stress for passengers caused by high-variance completion time distributions. We present a model that considers how passenger profiles, checkpoint components, and security policies affect completion time distributions. Illustrations highlight ways to reduce distribution variance.

3 - Combining Multiple Subjective Probabilities: Applications to Aviation Safety Risk Assessment

Kazim Topuz, PhD Student, Rutgers University, Department of Industrial & Systems Engin, 96 Frelinghuysen Road CoRE Building, Piscataway, NJ, 08854, United States of America, mktopuz@gmail.com, James T. Luxhoj

We focus on combining subjective probabilities in aviation safety. We used Subject Matter Experts in probability elicitation for separate risk assessment models. A composite model requires combining subjective probabilities. We proposed three probability combining protocols: Rational Combination is inspired by the Expected Utilization Theory; Irrational Combination is inspired by Prospect Theory; Realistic Combination involves using the results of the individual models selected to combine.

■ TA71

Mezzanine -101B

Air Systems Performance

Sponsor: Aviation Applications

Sponsored Session

Chair: Bo Zou, Assistant Professor, University of Illinois at Chicago, 842 West Taylor Street, 2073 ERF, Dept. of Civil and Materials Engineering, Chicago, IL, 60607, United States of America, bzou@uic.edu

1 - Integrated Airline Scheduling: Considering Competition Effects and the Entry of the High Speed Rail

Luis Cadarso, Technical University of Madrid, Pza. Cardenal Cisneros, 3, Madrid, 28040, Spain, luis.cadarso@upm.es, Vikrant Vaze, Cynthia Barnhart, Angel Marìn

Airlines and High-speed rail increasingly compete for passengers. Competition affects the number of captured passengers and revenues. We consider multi-modal competition and develop an approach that estimates the demand using a nested logit model, and generates schedules using an integrated optimization model. Our experimental results show how we replicate the current scheduling decisions of IBERIA (the major Spanish airline), and evaluate multiple scenarios accounting for demand stimulation.

2 - Aviation Fuel Loading: Efficiency vs. Options

Megan Ryerson, Assistant Professor, University of Tennessee, Department of Civil and Environmental Eng., 113 Perkins Hall, Knoxville, TN, 37996, United States of America, mryerson@utk.edu, Mark Hansen

Airlines uplift fuel in three main categories: mission, reserve, and contingency fuel. Contingency fuel allows aircraft additional holding time or diversion options in case of unforeseen events. However, as fuel is burned simply to carry fuel, this practice can be costly and harmful to the environment. Using airline data, we investigate the magnitude of excess fuel burn due to contingency fuel and trends related to the uplift of contingency fuel.

3 - Aviation System Reliability During Natural Disaster

Yoonjin Yoon, Assistant Professor, KAIST, 291 Daehak-ro, Yuseong-gu, Daejeon, 305-701, Korea, Republic of, yoonjin@kaist.ac.kr, Jiseon Lee

Increasing trend of natural disaster affects various modes of transportation and air transportation is no exception. In this study, we analyse the effect of volcanic ash to air transportation system performance at the national and worldwide level. We focus our analysis on Icelandic volcano ash event, and apply to the hypothetical case of Korea's Mt. Baekdoo eruption to assess the level of disruption to the Korean and nearby airspace.

4 - Cost Optimization under Capacity Uncertainty in Ground Delay Program: Single Airport Case

Yi Liu, University of California, Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com, Mark Hansen

We developed analytical models based on queuing diagram for delay cost optimization in the design of Ground Delay Program (GDP) under capacity uncertainty. Our cost includes delay planned at the beginning of the GDP, and penalty for change in the delay due to error in capacity prediction. Both the cases of early GDP cancellation and late GDP extension are considered in the mechanism.

■ TA72

Mezzanine -101C

Recent Advance in Stochastic Optimal Control

Cluster: Risk Management

Invited Session

Chair: Enlu Zhou, Assistant Professor, University of Illinois at Urbana-Champaign, 201D Transportation Bldg., 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, enluzhou@illinois.edu

1 - Infinite-Horizon Dynamic Programming with Non-Convex Risk-Sensitive Measures

Lin Kun, Research Assistant, University of Maryland, College Park, MD, United States of America, klin@umd.edu, Steve Marcus

The dynamic performance measure approach is a generalization of the classical work using expected value. One drawback of this approach is that it has only been developed for coherent performance measures, which exclude a large class of important non-convex performance measures. We remedy this drawback by proving the optimality of the dynamic programming equation for infinite-horizon problems with non-convex performance measures.

2 - Information-relaxation Based Value and Policy Iterations for Stochastic Control Problems

Nan Chen, Associate Professor, The Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk, Wei Yu

We develop an iterative approach to solve stochastic control problems based on the information relaxation technique. Upper and lower bounds for the value function are computed in each iteration. Both the bounds converge to the optimal value in finite steps of iterations.

3 - True Upper Bounds on Bermudan Option Prices under Jump-diffusion Processes

Fan Ye, University of Illinois, 104 S. Mathews Ave., 117 Transportation Bldg., Urbana, IL, 61801, United States of America, fanye2@illinois.edu, Enlu Zhou, Helin Zhu

Fast pricing of American-style options is difficult when the underlying asset prices follow some jump-diffusion processes. Based on the martingale duality approach we propose an algorithm to generate tight upper bounds on the Bermudan option price under the jump-diffusion setting, where an approximation of the optimal martingale is derived without nested simulation but preserves the martingale property. Numerical experiments are conducted to verify the efficiency of our proposed algorithm.

Tuesday, 11:00am - 12:30pm

■ TB01

Level 2 - Room 200A

Portfolio Optimization II

Cluster: Optimization in Finance

Invited Session

Chair: John Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - CVaR Proxies for Minimizing Scenario-based Value-at-Risk

Helmut Mausser, Risk Analytics Research, IBM, 185 Spadina Avenue, Toronto, ON, M5T 2C6, Canada, helmut.mausser@ca.ibm.com, Oleksandr Romanko

Minimizing VaR based on a set of scenarios is an integer programming problem. Solving to optimality may demand using only a small number of scenarios, which leads to poor out-of-sample performance. A simple alternative is to minimize CVaR for several different quantile levels and then to select the optimized portfolio with the best out-of-sample VaR. We show that this approach is both practical and effective, outperforming integer programming and an existing VaR minimization heuristic.

2 - Enhanced Indexation Based on Second-Order Stochastic Dominance

Gautam Mitra, President, Optirisk System, London, United Kingdom, gautam@optirisk-systems.com, Diana Roman, Victor Zverovich

Second order Stochastic Dominance (SSD) is well established in portfolio selection as it captures the behaviour of a risk-averse investor. SSD-based models construct a portfolio, whose return distribution SSD dominates the reference distribution. We present an empirical study which analyses the effectiveness of such strategies in the context of enhanced indexation;this leads to a unified framework which incorporates (a) SSD, (b) downside risk (CVaR) minimisation and (c) enhanced indexation.

3 - A Gradual Non-convexation Penalty Method for Minimizing VAR

Thomas Coleman, Professor and Ophelia Lazaridis University Research Chair, University of Waterloo, 200 University Ave. W, Waterloo, Canada, tfcoleman@uwaterloo.ca, Yuying Li

Computing an optimal portfolio with minimum value-at-risk (VaR) is computationally challenging since there are many local minimizers. We consider a nonlinearly constrained optimization formulation directly based on VaR definition in which VaR is defined by a probabilistic inequality constraint. Computational comparisons will be presented to illustrate the accuracy and efficiency of the proposed method.

4 - Introducing Distribution Uncertainty in Active Portfolio Management

Luis Chavez-Bedoya, Research Professor, Esan Graduate School of Business, Alonso de Molina 1652, Monterrico-Surco, Lima, Peru, l.chavezbedoya@gmail.com, John Birge

In the framework of active portfolio management, we propose a model based on generalized hyperbolic distributions to incorporate the relative confidence given to the consensus excess returns and the forecasted ones. This methodology provides a simple and intuitive way to incorporate distribution uncertainty, and to find closed-form expressions for the optimal portfolio weights.

■ TB02

Level 2 - Room 200B

Nonlinear Optimization Algorithms

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Frank Curtis, Assistant Professor, Lehigh University, 200 W Packer Ave., Bethlehem, PA, 18015, United States of America, frank.e.curtis@gmail.com

1 - Matrix-free Solvers for Systems of Inclusions

Hao Wang, ISE, Lehigh University, 200 West Packer Ave., Room 371, Bethlehem, PA, 18015, United States of America, haw309@lehigh.edu, James Burke, Frank Curtis, Jiashan Wang

Matrix free alternating direction and reweighting methods are proposed for solving systems of inclusions. The methods attain global convergence guarantees under mild assumptions. Emphasis is placed on their ability to rapidly find good approximate solutions, and to handle large-scale problems. Numerical results are presented for elastic QP subproblems arising in NLP algorithms.

2 - A BFGS Gradient Sampling Algorithm for Nonsmooth Optimization

Xiaocun Que, Lehigh University, 14 Duh Dr., Apt., 323, Bethlehem, United States of America, xiq209@lehigh.edu, Frank Curtis

We present an algorithm for solving nonsmooth and/or nonconvex optimization problems. Problems of this type arise in a variety of applications including robust optimization, eigenvalue optimization, compressed sensing, and decomposition methods for large-scale or complex optimization problems. This algorithm, which we call BFGS-GS, is based on the BFGS method and the gradient sampling algorithm. Preliminary results show that this BFGS-GS algorithm yields benefits over the BFGS method.

3 - A Globally Convergent Primal-dual Active-set Framework for Large-scale Convex Quadratic Optimization

Zheng Han, Ph.D. Candidate, ISE, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, zhh210@lehigh.edu, Frank Curtis, Daniel Robinson

We present a primal-dual active-set framework for large-scale convex quadratic optimization that can make multiple simultaneous changes in the active-set estimate and converge from arbitrary initial points. Each iteration of the framework involves solving a reduced subproblem, the cost of which can be reduced by incorporating inexactness. Preliminary results illustrate that this method often leads to rapid identification of the optimal active-set even for poorly conditioned problems.

■ TB03

Level 2 - Room 200C

Advances on Global Optimization and MINLP Algorithms

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Francisco Trespalacios, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, ftrespal@andrew.cmu.edu

1 - A Computational Comparison of SDP-based Methods for QCQPs

Jitamitra Desai, Assistant Professor, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, jdesai@ntu.edu.sg, Rupaj Kumar Nayak

There are several well-known convexification methods for solving nonconvex quadratically constrained quadratic programs (QCQPs). We introduce a new class of valid cutting planes based on SDP constructs that tighten convex relaxations of QCQPs. A further improvement by using a modified version of the triangle inequalities is also presented. Computational comparison across different types of relaxations shows the efficacy of these new cutting plane strategies.

2 - Tight Bounds on Non-convex Separable Quadratic Knapsack Problems with Box Constraints

Jaehwan Jeong, University of Tennessee, 1300 Clinch Ave. Apt3, Knoxville, TN, 37916, United States of America, jjeong3@utk.edu, Chanaka Edirisinghe

We present a new method for lower/upper bounds on the global optima of non-convex separable quadratic knapsack problems with box constraints, an NP-hard problem. The lower bound is obtained via the dual problem, whose solution is used to construct a feasible solution upper bound. The algorithm runs in linear time, in contrast to the polynomial-time method of Vavasis (1992) yielding local optima. Experiments show that our method produces better upper bounds than Vavasis more efficiently.

3 - Non-convex QP in CPLEX

Christian Bliek, IBM, 1681 HB2 Route des Dolines, Valbonne, 06560, France, bliek@fr.ibm.com, Pierre Bonami

We present the techniques used in CPLEX to solve non-convex QP and will show the performance on a number of benchmarks.

■ TB04

Level 2 - Room 200D

Joint Session OPT IP/OPT Global: Bilevel and Multilevel Optimization: Algorithms and Applications

Sponsor: Optimization/Integer Programming & Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Behdad Beheshti, PhD Candidate, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, beb65@pitt.edu

1 - Robust Single-machine Scheduling Problem with Budgeted Uncertainty in Processing Times of Jobs

Bita Tadayon, University of Florida (Industrial and Systems Engineering department), 406 Weil Hall, University of Florida, Gainesville, FL, 32608, United States of America, bitanhj@ufl.edu, J. Cole Smith

We study 4 alternative optimization criteria in a robust single-machine scheduling problem. Uncertain processing times are modeled by closed intervals such that the ratio between their upper- and lower-bound values is the same for all intervals. Three alternative uncertainty sets are introduced to moderate the worst-case scenario in the problem. We discuss the complexity of the problem with each criterion under each uncertainty set, and provide optimal algorithms for polynomially solvable cases.

2 - Multilevel Models in Stochastic Programming with Coherent Risk Measures

Jonathan Eckstein, Professor, Rutgers University, 100 Rockefeller Road, Piscataway, NJ, 08540, United States of America, jeckstei@rci.rutgers.edu

Although there is only decision maker, we propose a multilevel optimization modeling scheme that allows simple coherent risk measures to be used in multistage stochastic program without running afoul of time inconsistency. We have proven that the resulting models are NP-hard even in the simplest cases, but argue empirically that some nontrivial practical instances may not be difficult to solve. Our models also have special structure that may allow the development of customized algorithms.

3 - Exact Solution Approach for the Bilevel Assignment Problem
Behdad Beheshti, PhD Candidate, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, beb65@pitt.edu, Oleg Prokopyev

We consider the bilevel assignment problem in which each decision-maker (i.e., the leader and the follower) controls a subset of edges and each edge has a leader's and a follower's costs. The leader acts first by choosing some of his/her edges and then the follower completes the assignment process in order to construct a perfect matching. We propose a branch-and-cut algorithm to solve the problem. Preliminary computational results are encouraging.

■ TB05

Level 2 - Room 200E

Optimization in Energy Networks

Sponsor: Optimization/Networks

Sponsored Session

Chair: Erick Moreno-Centeno, Assistant Professor, Texas A&M University, 4034 ETB, College Station, TX, 77843, United States of America, e.moreno@tamu.edu

1 - Transmission Expansion with Demand and Contingency Uncertainty and Transmission Switching
Kathryn Schumacher, PhD Candidate, University of Michigan, Industrial & Operations Eng. Dept., Ann Arbor, MI, United States of America, kaschu@umich.edu, Richard Chen, Amy Cohn

We consider the robust transmission expansion problem where feasible operation is desired for all reasonable demand/renewable generation values and for all plausible contingency events. Furthermore, we consider the situation where transmission switching is an allowable recovery action. We present a model of this problem, and an algorithm to solve this model. Computational results will be discussed.

2 - Scenario-based Reserve Policies for Transmission-constrained Unit Commitment
Joshua Lyon, PhD Student, Arizona State University, PO Box 875706, Tempe, AZ, United States of America, jdlyon@asu.edu, Muhong Zhang, Kory Hedman

On a daily basis, grid operators solve a MIP (unit commitment) that includes a network flow problem (optimal power flow) and reliability standards (N-1). Currently, deterministic reserve policies are used to approximate the standby capacity that is needed to ensure reliable operations. New reserve policies are proposed that efficiently address reserve deliverability on a per-scenario basis without increasing the number of variables and adding only a trivial number of constraints to the problem.

3 - An Affine Arithmetic Method to Solve Stochastic Optimal Power Flow Problems with Uncertainties
Mehrdad Pirnia, University of Waterloo, 200 University Ave. W, Waterloo, On, N2L3G1, Canada, mpirnia@uwaterloo.ca, Claudio Canizares, Kankar Bhattacharya, Alfredo Vaccaro

An affine arithmetic (AA) method is proposed to solve an optimal power flow problem with uncertain generation sources. In the AA-based OPF problem, all the state and control variables are treated in affine form to represent forecast, model error, and other sources of uncertainty. Furthermore, the proposed AA-based OPF problem is applied to the determination of operational margins of the thermal generators in grids with renewable generation.

4 - Real-time Optimization of Complex Energy Systems on High-performance Computers
Cosmin Petra, Argonne National Laboratory, Argonne, IL, United States of America, petra@mcs.anl.gov

Stochastic optimization of complex energy systems results in extremely large optimization problems that can be solved only by means of high-performance computing (HPC). We present the latest algorithmic and implementation developments within our solver parallel PIPS that are aimed at reducing the solution times and solving stochastic economic dispatch and unit commitment problems in real-time on HPC platforms. We also present numerical experiments on IBM BG/P, Cray XK7 and XC30 architectures.

■ TB06

Level 2 - Room 200F

Humanitarian Logistics and Disaster Response

Sponsor: Optimization/Networks

Sponsored Session

Chair: Victor Pereira, PhD Candidate, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, vpereira@vt.edu

1 - The Ritter Decomposition Algorithm Applied to the Bus Evacuation Problem
Victor Pereira, PhD Candidate, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, vpereira@vt.edu, Douglas Bish

This presentation introduces a variation of the Bus Evacuation Problem where evacuees arrive at the pick-up locations at a constant rate, from the onset of the evacuation to a location-specific evacuation deadline. In addition, a solution approach relying on a variation of the Ritter Decomposition Algorithm to solve bordered-structure problems with quadratic objective functions and 0-1 mixed integer subproblems is proposed. Empirical results are discussed.

2 - Adaptive Orienteering Problem with Stochastic Travel Times
Irina Dolinskaya, Assistant Professor, Northwestern University, 2145 Sheridan Road, IEMS, Evanston, IL, 60208-3119, United States of America, dolira@northwestern.edu, Zhenyu (Edwin) Shi, Karen Smilowitz

We study the setting of search and rescue (SAR) operations following a disaster, where the goal is to search collapsed structures within the area to rescue as many survivors as possible within a deadline. The decision problem of a SAR team can be formalized as an adaptive orienteering problem with stochastic travel times that integrates path finding between the reward nodes. We present the model, algorithms and analysis of results.

3 - An Integrated Disaster Relief Supply Chain Network Model with Time Targets and Demand Uncertainty
Amir Masoumi, Assistant Professor of Operations Management, Manhattan College, 4513 Manhattan College Pkwy, Riverdale, NY, 10471, United States of America, amir.masoumi@manhattan.edu, Min Yu, Anna Nagurney

We develop a supply chain network model for a disaster relief organization in charge of serving certain disaster-prone regions. Our system-optimization approach utilizes goal programming to enforce the timely delivery of relief items with respect to the pre-specified time targets at the demand points subject to the uncertain demand being satisfied as closely as possible. The modeling framework integrates the two policies of pre-positioning as well as post-disaster procurement of relief supplies.

■ TB07

Level 2 - Room 200G

Robust Optimization and Its Applications II

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Dan Iancu, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, 94305, United States of America, daniancu@stanford.edu

Co-Chair: Nikos Trichakis, Harvard University, Cambridge, MA, United States of America, ntrichakis@hbs.edu

1 - Practical Guide for Robust Linear Optimization
Dick den Hertog, Professor, Tilburg University, Tilburg, Netherlands, D.denHertog@uvt.nl

It is remarkable that real-life applications of Robust Optimization is still lagging behind; there is much more potential for real-life applications than has been exploited hitherto. We pinpoint several issues that are important when applying Robust Optimization and that are often not well understood and even incorrectly applied by practitioners. We also provide a general recipe for Robust Linear Optimization that may be helpful for successful applications.

2 - A Tractable Analysis of the Transient Behavior of Multi-server Queues

Nataly Youssef, Massachusetts Institute of Technology, Cambridge, MA, United States of America, youssefn@mit.edu, Chaithanya Bandi, Dimitris Bertsimas

We propose an analytically tractable approach for studying the transient behavior of multi-server queues with heavy tailed arrival and service processes. We model the queueing primitives via polyhedral uncertainty sets and take a robust perspective. We report computational results that suggest that our new method leads to remarkable closeness to simulation results for a wide range of parameters such as traffic intensity, heavy tail coefficients and number of servers.

3 - Static vs Adjustable Solutions in Two-stage LPs under Constraint Uncertainty

Vineet Goyal, Columbia University, New York, NY, United States of America, vgoyal@ieor.columbia.edu, Dimitris Bertsimas, Brian Lu

We study the performance of static solutions for two-stage robust packing linear programs with uncertain constraint coefficients and give a tight characterization of adaptivity gap. Computing an adjustable robust optimization problem is often intractable. We give a tight characterization for the optimality of static solutions and a tight approximation bound related to a measure of non-convexity of a transformation of uncertainty set. Our bound is significantly stronger than the symmetry bound.

■ TB08

Level 2 - Room 200H

Constraint Programming I

Sponsor: Computing Society

Sponsored Session

Chair: Willem-Jan van Hoeve, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, vanhoeve@andrew.cmu.edu

1 - Decision Diagrams for Sequencing and Scheduling Problems

Andre Cire, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, acire@andrew.cmu.edu, John Hooker, David Bergman, Willem-Jan van Hoeve

Decision diagrams (DDs) have recently been introduced as a means to obtain a discrete relaxation for combinatorial optimization problems. In this talk, we discuss how DD-based relaxations can be used to model and solve a variety of sequencing and scheduling problems. We also describe techniques which allow the relaxation to be combined with constraint programming and integer programming technologies.

2 - Decision Diagrams for Discrete Optimization

David Bergman, Carnegie Mellon University, Pittsburgh, PA, United States of America, dbergman@andrew.cmu.edu, John Hooker, Andre Cire, Willem-Jan van Hoeve

In this talk, we describe a decision diagram based branch-and-bound algorithm for discrete optimization problems. We discuss the application of the technique to several problems, including those that are often modeled with nonlinear terms. Experimental results suggest that the algorithm is competitive with state-of-the-art general purpose solvers.

3 - Decision Diagrams and Dynamic Programming

John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, jh38@andrew.cmu.edu

Binary and multivalued decision diagrams are related to dynamic programming (DP) but differ in some important ways. This talk incorporates DP with state-dependent costs into the theory of decision diagrams and generalizes a well-known uniqueness theorem for reduced diagrams. This can lead to simplification of DP models by transforming the costs to "canonical" costs and reducing the diagram, as illustrated by a standard inventory management problem.

■ TB09

Level 2 - Room 200I

Dynamic Pricing/Inventory Control

Sponsor: Analytics Section

Sponsored Session

Chair: Xiting Gong, The Chinese University of Hong Kong, Dept. of Systems Eng. and Eng. Mgmt., Hong Kong, Hong Kong - PRC, xtgong@se.cuhk.edu.hk

1 - Coordinating Inventory Control and Pricing Strategies for Perishable Products

Xin Chen, Associate Professor, University of Illinois at Urbana-Champaign, 104 S. Matthews Avenue, Urbana, IL, 61801, United States of America, xinchen@illinois.edu, Zhan Pang, Limeng Pan

We analyze the joint pricing and inventory control problem of a perishable product with a fixed lifetime and price-dependent demand over a finite horizon. The objective is to find a joint pricing, ordering, and disposal policy so as to maximize the total expected discounted profit over the planning horizon taking into account linear ordering cost, inventory holding and backlogging or lost-sales penalty cost and disposal cost.

2 - Approximation Algorithms for Capacitated Stochastic Inventory Systems with Setup Cost

Cong Shi, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, shicong@gmail.com, Retsef Levi, Xiuli Chao, Huanan Zhang

We develop the first approximation algorithm with worst-case performance guarantee for capacitated stochastic periodic-review inventory systems with setup cost. We construct efficient near-optimal policies for these systems whose demands can be correlated over time, and show that these policies have a worst-case performance guarantee of 4. We also demonstrate that the policies empirically perform close to optimal, which is significantly better than the theoretical worst-case guarantee.

3 - Joint Control of Emissions Permit Trading and Production with Fixed-cost Considerations

Jian Yang, Associate Professor, Rutgers University, 1 Washingtong Park RM 1084, Newark, NJ, 07102, United States of America, jyang@business.rutgers.edu, Quan Yuan, Frank (Youhua) Chen, Yun Zhou

We study the optimal coordination of permit trading and permit-consuming production for a firm facing both Markov permit price process and random demand during a multi-period planning horizon. Fixed setup costs first in trading and then in production are considered. We achieve partial characterization of control policies. A heuristic based on decomposition is found to be effective from computational studies.

4 - Approximation Algorithms for Stochastic Perishable Inventory Control Models

Xiting Gong, The Chinese University of Hong Kong, Dept. of Systems Eng. and Eng. Mgmt., Hong Kong, Hong Kong - PRC, xtgong@se.cuhk.edu.hk, Xiuli Chao, Cong Shi, Huanan Zhang

We develop two approximation algorithms for stochastic perishable inventory control models with an arbitrary fixed lifetime. Specifically, we develop an algorithm for the models with a general demand process and an algorithm for the models with an independent and non-decreasing demand process. We show that these two algorithms have worse-case performance guarantees between 2 and 3 and 2, respectively. Extensive numerical studies demonstrate near optimal performances for both algorithms.

■ TB10

Level 2 - Room 200J

Risk Models and Optimization in Supply Chains

Cluster: Managing Disruptions in Supply Chain

Invited Session

Chair: Edward Huang, Assistant Professor, George Mason University, Engr Bldg, Rm 2100, MS 4A6, George Mason University, Fairfax, VA, 22030, United States of America, chuang10@gmu.edu

1 - An Empirical Analysis of Power in Supply Networks: A Buyer Supplier Perspective

Steven Carnovale, Ph.D. Candidate, Rutgers Business School, 1 Washington Park, Room 1057B, Newark, NJ, 07102, United States of America, scarnova@pegasus.rutgers.edu, Sengun Yeniyurt

A common control mechanism in supply-networks are equity-based arrangements such as joint-ventures. Yet, firms are often at the behest of powerful suppliers or buyers. We take a network-theory perspective of power in supply-chain-networks and empirically investigate the role that power plays for buyers and suppliers in new manufacturing joint-venture formations.

2 - Robust Electrical Distribution Network Design under Uncertainty

Pratik Mital, Ph.D. Student, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, pratik_mital@gatech.edu, Edward Huang, Marc Goetschalckx

Outages due to natural disasters like hurricanes, earthquakes etc. or due to falling of trees can render parts of the network to become dysfunctional and results in the customers losing power. The network should be robust under these uncertain events to maintain a high level of electrical service reliability. The uncertainty of the future is modeled as a set of scenarios. An optimization model is developed that re-designs the existing power network to make it more robust under uncertainty.

3 - A Mixed Integer Programming Approach for Cybersecurity Risk Planning

Tadeusz Sawik, Professor, AGH University of Science & Technology, Al.Mickiewicza 30, Krakow, 30059, Poland, ghsawik@cyf-kr.edu.pl

Using a mixed integer programming with CVaR as a risk measure, a subset of available countermeasures is selected for implementation under limited budget, to minimize the expected and/or worst-case losses from successful cyber-attacks. The effectiveness of countermeasures for blocking different cyber-threats and the probability of potential attack scenarios are considered.

■ TB11

Level 2 - Room 201A

Spotlight on CAREER Award Winning Research

Sponsor: Minority Issues

Sponsored Session

Chair: Julie Ivy, Associate Professor, North Carolina State University, Edward P. Fitts Department of Industrial, 400 Daniels Hall, Raleigh, NC, 27695-7906, United States of America, jsivy@ncsu.edu

1 - Career: Monotone Optimal Policies in Parallel Processing Networks

Mark Lewis, Professor, Cornell University, Ithaca, NY, 14853, United States of America, mark.lewis@cornell.edu, Robert Hampshire

In this talk, I will discuss some of the technical aspects of my proposal, expand on how those questions were answered, what extensions were pursued and how the CAREER grant 'jumpstarted' my career. I will then discuss how the education component continues to guide my approach to service to the community through teaching and mentorship.

2 - Incorporating Patient Heterogeneity and Choice into Predictive Models of Health & Economic Outcomes

Maria Mayorga, Clemson University, Raleigh, NC, United States of America, mayorga@clemson.edu

The goal is to obtain better predictions of the effectiveness of population-level health interventions by incorporating consumer choice models and accounting for patient heterogeneity in predictive models of health and economic outcomes. An example is presented for colo-rectal cancer screening guidelines. The educational plan includes advising and mentoring activities that work with discovery-oriented projects involving multi-level student teams.

■ TB12

Level 2 - Room 201B

KINFORMS

Cluster: KINFORMS

Invited Session

Chair: Sang Hyung Ahn, Professor, Seoul National University, Business School, Seoul, Korea, Republic of, shahn@snu.ac.kr

1 - Product/Service Quality and Loyalty in a Korean Auto Company

Hosun Rhim, Korea University, Seoul, Korea, Republic of, hrhim@korea.ac.kr, Hye Jeong Bae, Kwangtae Park

We measure service quality based on service process, and examine relationships among product/service quality, and product/service loyalty. We develop a construct to evaluate process based service quality. We collect data from customers of auto maintenance centers to measure perceived quality and loyalty. We test relationships between constructs using a structural equation model and regression analysis.

2 - Technology Level Assessment in Korea

Chang Won Lee, Professor, Hanyang University, School of Business, Korea, Republic of, leecw@hanyang.ac.kr, Sang Hyung Ahn

This paper is to present Technology Level Assessment (TLA) in Korea. Certain industry is selected for the TLA study. Regression analysis is used for developing TLA model. The study results will provide decision-makers and policy-makers of technology level planning with strategic insights.

3 - Reducing Customer Waiting Time in Baggage Handling Systems (BHS)

Hongsuk Yang, Seoul National University, 1 Gwanak-ro Gwanak-gu, Seoul, 151-916, Korea, Republic of, hongsuk@snu.ac.kr, Changhee Kim

The purpose of this study is to find an operational rule to minimize customer waiting time in Baggage Handling Systems (BHS) of airports. We consider three sorting rules and analyze waiting time of customers: traditional FIFO sorting, 2 Group (Business class and Economy class) sorting and Line sorting (each line of airplane seat). We suggest an effective sorting rule for Baggage Handling Systems.

4 - Hospital Cost Efficiency Measurement Associated with Quality

Jeong Hoon Choi, Assistant Professor, The University of Akron, 259 South Broadway, Akron, OH, 44325, United States of America, jhchoi@uakron.edu

This study measures cost efficiency of hospitals using Data Envelopment Analysis, while adding quality variables as output factors, and compares the results with those of traditional models where quality variables are not considered as outputs. This study employs mortality rate of three major causes of death as well as traditional output variables such as total patient revenue, number of discharge, and inpatient days. This study analyzes hospitals in groups by control type, region, and size.

5 - Multi-period Shipment Consolidation Strategy

Wooseung Jang, Professor, University of Missouri, E3437 Lafferre Hall, Columbia, MO, 65211, United States of America, JangW@missouri.edu, Na Deng

Recent transportation activities have significantly changed the design and operation of international logistics networks. In particular, shipment consolidation has become a key factor that affects the cost and service quality of logistics operation. In this work, we consider a multi-period multi-commodity consolidation problem and propose math-programming based solution approaches.

■ TB13

Level 2 - Room 202A

New Product Development I: Technology Selection and Innovation

Contributed Session

Chair: Amir Sanayei, Graduate Research Assistant, Wayne State University, Detroit, MI, United States of America, sanayei@wayne.edu

1 - Incentive Scheme for Globally Dispersed Product Development Teams

Sara Rezaee Vessal, HEC Paris, 1, Rue de la Liberation, Jouy en Josas, 78350, France, sara.rezaee-vessal@hec.edu, Svenja Sommers

To successfully compete on an international scale, companies increasingly turn towards globally dispersed product development teams, both to draw on a diverse set of expertise and to access more accurate local market knowledge. However, these teams also face additional challenges in terms of coordination and differences in objectives. In this study, we address the question how to design incentive schemes to achieve the firm's global objectives.

2 - Flexibility and Risk Management in Collaborative Product Development

Suri Gurumurthi, UNC Kenan-Flagler Business School, 3516 Sawtelle Blvd, Los Angeles, CA, 90066, United States of America, Suri_Gurumurthi@kenan-flagler.unc.edu

Risk in collaborative innovation projects arises from multiple sources: uncertain task requirements, resource capabilities, inadequate partner investments, and eventually market demand. We measure the relative impact of these sources of risk on PD performance, and identify sound risk management principles that leverage and plan for flexibility in the PD environment.

3 - Optimal Product Design Strategy: The Role of Component Sharing and Concurrent Engineering

Yufei Huang, PhD Student, University College London, Gower Street, London, WC1E 6BT, United Kingdom, yufei.huang.10@ucl.ac.uk, Bilal Gokpinar

Component sharing and concurrent engineering are two popular design strategies for many product development firms. We study the interplay between these two strategies and propose an analytical model to find the optimal concurrency level to minimize both short term and long term costs. We then empirically test our model using data from automotive industry.

4 - Tacit Knowledge and Product Innovation in the Multinational Corporation

Margaret Sheng, National Taiwan University of Science and Technology, 43, Keelung Road. Section 4, Taipei, Taiwan - ROC, msheng@mail.ntust.edu.tw

Our study applies a contingent perspective to examine how the social cognition influences the relationship between tacit knowledge and product innovation of multinational corporations (MNCs). It focuses on social cognition as a potential enhancement of the MNC's ability to convert tacit knowledge into product innovation. The results show that the effect between tacit knowledge and product innovation is stronger for higher levels of organic structure, trust, and self-efficacy.

5 - Technology Selection and New Product Development in a Competitive and Uncertain Environment

Amir Sanayei, Graduate Research Assistant, Wayne State University, Detroit, MI, United States of America, sanayei@wayne.edu, Leslie Monplaisir

Technology selection is one of the most important decisions made in new product development process that can critically affect product success factors.Although new prospective technologies can bring more competitive advantage by offering higher performance comparing with old and proven technologies,but could also be riskier.In this paper,we developed a model to select best technology choices in different design scenarios and investigate effects of uncertainty in a competitive market environment.

■ TB14

Level 2 - Room 202B

Location Models IV

Sponsor: Location Analysis

Sponsored Session

Chair: Mozart Menezes, Associate Professor, University of Calgary, 2500 University Dr. NW, Calgary, AB, T2N1N4, Canada, mozart.menezes@ucalgary.ca

1 - A Continuum Approximation Approach to the Dynamic Facility Location Problem

Xin Wang, University of Illinois at Urbana-Champaign, 111 E Healey St Apt 202, Champaign, 61820, United States of America, wangxin1@illinois.edu, Yanfeng Ouyang, Michael Lim

We propose a continuum approximation framework to solve a dynamic facility location problem for a large-scale growing market. Using a tube-regulation procedure, we convert the CA solution back into discrete facility locations and illustrate the performance of our algorithm.

2 - Allocation on Riemannian Manifolds

Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu, Samir Alwazzi, Theodore B. Trafalis

Known formulas to solve the facility allocation problem (FAP) in the literature assume either a planar or spherical surface with the allocation of the facilities to be changing either discretely or continuously. In this work we use Riemannian Manifold Surfaces with geodesic distances to allocate facilities; a generalization of the known surface and distance assumptions.

3 - Integrated Replenishment and Inbound Transportation Problem with Batch Ordering

Erhan Kutanoglu, The University of Texas at Austin, ORIE, Austin, United States of America, erhank@mail.utexas.edu, Ying Chen

The problem is motivated by an actual project with a high-mix assembly plant, which is currently located far from most of its contract suppliers. Each supplier provides various parts to the plant, and the parts may have package quantities that satisfy demands for different time horizons. We formulate and solve the problem to find the most beneficial integrated policy of inbound shipping and inventory management when order quantities are restricted to be integral multiples of package quantities.

4 - Approximation Algorithms for Location-routing Problems: Creating Benchmark for Strategic Decisions.

Mozart Menezes, Associate Professor, University of Calgary, 2500 University Dr. SE, Calgary, AB, T2G5R4, Canada, mozart.menezes@utoronto.ca, Vedat Verter, Rongbing Huang, Serigne Gueye

We aim in identifying opportunities for improvement in real-world location-routing problems. Create an approximation scheme for location and routing problems that is easy to implement, provides a reasonable good feasible solution, provides lower bounds on costs, and provides procedures for adapting different real situations so the scheme presented could be used. We present results discriminating measures such as vehicles' capacity utilization, technology, distance travelled, and CO2 emissions.

■ TB15

Level 2 - Room 203

Best Paper Award - Competitive Presentations I, Service Science Section

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, Distinguished Professor, National Taiwan University, 1, Sec. 4, Roosevelt, Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw

1 - Solving Blood Mobile Routing Problem of a Blood Center

Serkan Gunpinar, PhD, University of South Florida, 4202 East Fowler Avenue, ENB118, Tampa, FL, 33620, United States of America, sgunpina@mail.usf.edu, Grisselle Centeno

Every day, a blood center selects a set of locations among a group of potential locations to collect blood so as to minimize the delivery cost and to avoid shortfalls. We develop an integer programming technique to model blood mobile routing problem of a blood center and apply column generation and branch & bound methodologies to solve it. Through extensive numerical experiments computational results will be presented.

2 - Applying Theory of Constraints to Software as a Service

John Ricketts, Distinguished Engineer, IBM, 650 Third Ave. S., Minneapolis, MN, 55402, United States of America, jaricke@us.ibm.com

Theory of Constraints (TOC) introduced unconventional methods for managing operations and inventory in Manufacturing and Distribution. TOC has been extended to labor-based services, including Professional, Scientific, Technical, Healthcare, and Educational Services. TOC is also being applied to technology-based services, including Software as a Service (SaaS). This paper includes SaaS examples from Analytics, Commerce, and Cities.

3 - Stochastic Modeling Approaches for Managing Energy Footprints and Cloud Computing Service

Siqian Shen, Assistant Professor, University of Michigan, 2793 IOE, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, siqian@umich.edu, Jue Wang

We consider a problem in a data center that operates homogeneous servers to provide cloud computing services. The goal is to minimize energy footprints and to maintain desired quality of service (QoS). We formulate stochastic models with various QoS requirements to optimize the trade-off, and propose decomposition and heuristic approaches for solving the models. Numerical results demonstrate noticeable energy savings, and computational efficacy of the proposed approaches.

■ TB16

Level 2 - Room 204

Stochastic Operations Research in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Soroush Saghafian, Arizona State University, 699 S. Mill Avenue, Tempe, AZ, 85281, United States of America, Soroush.Saghafian@asu.edu

1 - Modeling Emerging Challenges in Healthcare

Diwakar Gupta, Professor, University of Minnesota, 130B Mechanical Engineering, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, guptad@me.umn.edu, Sandra Potthoff

In an effort to curb growth in healthcare expenditures, payers are increasingly demanding better health outcomes. They are also transferring risk to providers by moving away from fee-for-service to other payment models, such as prospective payment and bundled payment paradigms. These changes are serving as catalysts for innovation in service delivery. This talk will focus on new challenges for hospital administrators, relevant OM literature, and authors' efforts to model emerging challenges.

2 - The Impact of Organizational Familiarity on Ambulance and A&E Department Performance

Jonas Oddur Jonasson, PhD Student, London Business School, Regent's Park, London, United Kingdom, jonas.oddur.jonasson@gmail.com, Sarang Deo, Kamalini Ramdas, Zeynep Aksin

We explore how behavioural and operational factors, such as on-the-job learning, affect performance in ambulance systems. Hypotheses are tested on detailed data on the 2 million ambulance activations undertaken by London ambulances in 2011. Results indicate that handover performance of an ambulance base and a hospital improves with their joint experience. However, at high levels of joint experience, performance may worsen. This may have implications for theoretical models of ambulance systems.

3 - Optimal Simultaneous Dynamic Monitoring and Treatment Control for Chronic Diseases

Pooyan Kazemian, PhD Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, pooyan@umich.edu, Joshua Stein, Mark Van Oyen, Jonathan Helm, Mariel Lavieri

Leveraging stochastic control theory, we address the problem of dynamic monitoring and control of chronic diseases. We present how, without loss of optimality in the joint control problem, one can find the optimal control of disease risk factors separately from the optimal timing of tests and the optimal set of tests. The patient-centered model optimizes disease monitoring and controls risk factors to limit disease progression. Glaucoma is discussed as a case study.

4 - The Role of Flexible Beds in Bed-block Management

Soroush Saghafian, Arizona State University, 699 S. Mill Avenue, Tempe, AZ, 85281, United States of America, Soroush.Saghafian@asu.edu, Ohad Perry

The bed-block phenomenon refers to situations in which Emergency Department (ED) patients who need to be hospitalized cannot be transferred to Inpatient Wards (IW) due to lack of available beds. In some instances, if patients block beds for a long time, they are transferred to so-called "flexible beds," i.e., beds that are not in their designated IW. We emphasize the role of flexible beds, and find effective patient transfer and discharge guidelines that can alleviate the bed-block.

■ TB17

Level 2 - Room 205A

Service Co-Production

Sponsor: Service Science

Sponsored Session

Chair: Rama Akkiraju, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, akkiraju@us.ibm.com

1 - Co-opetition in Services: The Boardwalk Phenomenon

Srinagesh Gavirneni, Cornell University, Johnson School of Management, Ithaca, NY, 14853, United States of America, nagesh@cornell.edu, Jim Dai, Xuchuan Yuan

We consider the setting in which service firms (e.g. restaurants) that compete on price and/or waiting time and cooperate on entertainment effort that reduces the cost of waiting for the patrons. We study monopoly and duopoly settings and in the latter, we consider both individual and joint entertainment efforts. We show that by cooperating on entertainment, the competing service firms are able to achieve efficiency levels equivalent to that of monopoly settings.

2 - Pricing Co-production in Services: Is it Better to Charge or to Barter?

Francesco Moresino, Professor, Haute Ecole de Gestion de Genève, HESSO, 7 Route de Drize, Genève, 1227, Switzerland, francesco.moresino@hesge.ch, Emmanuel Fragnière

We propose a model that extends Lovelock's tripod for the pricing of a service. In addition to the three elements proposed by Lovelock (competition, cost structure, and client's perceived value), we show that the price of a service should also take into account coproduction. We demonstrate that the co-producer can either be rewarded with cash or paid in nature. In this latter case, the co-producer is paid by a service especially tailored for her and coproduction can be seen as barter.

3 - Service Co-design

Rama Akkiraju, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, akkiraju@us.ibm.com

Traditional service design and delivery models that focus on operational excellence work well for delivering high quality but run-of-the-mill services. They are inadequate for pushing new boundaries and innovating new services. We present service co-design, a next generation service design approach to enable companies to design services that meet their growth and innovation needs.

■ TB18

Level 2 - Room 205B

Healthcare

Sponsor: Service Science

Sponsored Session

Chair: A. James Baroody, Rovhester Institute of Technology, Saunders College of Business, Rochester, NY, United States of America, jbaroody@saunders.rit.edu

1 - The Impact of Failure on Performance Over Time: The Case of Cardiac Surgery Operations

Emmanouil Avgerinos, PhD Student, University College London, Gower Street, London, United Kingdom, emmanouil.avgerinos.10@ucl.ac.uk, Bilal Gokpinar

In many knowledge-intensive service settings where human action is critical, failure is a reality. In this study, we examine the relationship between previous failures and subsequent operational performance both at the team and individual level. Using a large scale data from more than 6,000 cardiac surgeries in a European hospital over seven years, we investigate mechanisms through which task failure affects future productivity and performance.

2 - Logics of Health: System Dynamics and Institutional Logics of Health IT

A. James Baroody, Rovhester Institute of Technology, Saunders College of Business, Rochester, NY, United States of America, jbaroody@saunders.rit.edu, Sean Hansen

In this research, we employ the framework of institutional logics to examine the adoption of electronic health records (EHRs) technology in the U.S. healthcare industry. Complementary and conflicting institutional logics are examined from a systems perspective to evaluate implications for healthcare providers as they consider the adoption of EHR platforms. Combining Institutional Logics with System Dynamics is used to examine the interplay of multiple institutional logics upon EHR adoption.

3 - Performance Improvement for Emergency Medical Services via Systems Thinking and GIS

Jiun-Yu Yu, Department of Business Administration, No. 1, Section 4, Roosevelt Road, Da-An, Taipei, 106, Taiwan - ROC, jyyu@ntu.edu.tw

Emergency Medical Services refers to both patient transport and medical support for people with illnesses or injuries. Most past research about EMS is conducted from clinical view. To verify that the patient's health benefits can be enhanced from a better designed and implemented EMS process and to identify achievable potentials for performance improvement, this study proposes a model based on tools of OR/MS, operations management,systems thinking, and Geographical Information System.

■ TB19

Level 2 - Room 205C

Stochastic Models and Applications - I

Sponsor: Applied Probability

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, Madison, WI, United States of America, ananth@engr.wisc.edu

1 - Optimizing Downstream Biomanufacturing Operations under Quality Constraints and Batch Failures

Tugce Martagan, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, martagan@wisc.edu, Ananth Krishnamurthy

We develop a continuous state, discrete time Markov Decision Process model to optimize downstream purification processes in a biomanufacturing facility. The model combines the physical characteristics of chromatography (column dimensions, resin binding capabilities) along with process reliability (yields, failures, and constraints on purity levels) to determine optimal policies.

2 - Optimal Allocation Policy for Parallel Queues with a Shared Pool of Servers

Ravi Kumar, PhD Candidate, Cornell University, School of Operations Research and Inform, 292 Rhodes Hall, Ithaca, NY, 14850, United States of America, rk454@cornell.edu, Mark Lewis

We consider the problem of how servers can be dynamically allocated in a system with parallel queues serving multiple job types. A central controller has access to a fixed number of servers and must decide how many servers to use and where to allocate their effort. The system incurs holding costs based on the number of jobs in the system and usage costs based on the number of servers utilized. We give a characterization of the optimal allocation policy.

3 - Optimal Access Control Policies in Systems of Two Tandem Queues with Loss

Daniel Silva, Georgia Institute of Technology, Atlanta, GA, United States of America, dfsi3@gatech.edu, Hayriye Ayhan

We study two queues in tandem with finite arbitrary capacity buffers, Poisson arrivals at the first, and exponential service times. Losses are incurred when a customer is rejected upon arrival or when the second station is full upon service completion at the first. The goal is to find an optimal admission control policy to minimize long-run average cost. We provide conditions for two special policies to be optimal and, for general cases, propose heuristic policies with near optimal performance.

■ TB20

Level 2 - Room 205D

Revenue Management in Retail

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Andrew Vakhutinsky, Revionics, 2998 Douglas Blvd, Suite 350, Roseville, CA, 95661, United States of America, Andrew.Vakhutinsky@revionics.com

1 - The Impact of Promotion Optimization

Maxime Cohen, Massachusetts Institute of Technology, Cambridge, MA, United States of America, maxcohen@mit.edu, Kiran Panchamgam, Georgia Perakis, Zachary Leung, Tony Smith

We study the Promotion Optimization Problem, i.e. deciding which items to promote and at what price. Our formulation includes several business rules that arise in practice. We build demand models from data in order to capture the stockpiling behavior through dependence on past prices. This gives rise to a hard problem. For general additive and multiplicative demand structures, we propose efficient LP based methods, show theoretical performance guarantees and validate our results using real data.

2 - How Consumers Shop Online: Data, Models and Pricing Decisions

Zachary Leung, Massachusetts Institute of Technology, Cambridge, MA, 02139, United States of America, zacleung@mit.edu, Georgia Perakis, Pavithra Harsha

We study an Internet retailer selling fashion items. We propose a demand model, where customers may not buy the item on their initial visit, but return over time and may purchase items on subsequent visits. We propose and analyze a markdown optimization pricing model with returning customers. Using clickstream data collected from an online fashion retailer, we estimate our demand model and quantify the benefit of applying our model.

3 - Integrated Inventory, Pricing and Refund Policy Decisions for Online Retailers

Mehmet Sekip Altug, Assistant Professor, George Washington University, 2201 G. Street NW, Washington, DC, 20052, United States of America, maltug@gwu.edu, Tolga Aydinliyim

We study how retailers' return policy choices are affected by consumers' discount-seeking behavior. We study this problem in a newsvendor setting in which a monopolist retailer needs to make a stocking, pricing and a refund decision. Interestingly, when the return rate is below a threshold, we find out that retailers will stock more and price higher. We then study multiple competing retailers.

4 - Decomposition Approach to Retail Markdown Optimization

Andrew Vakhutinsky, Revionics, 2998 Douglas Blvd, Suite 350, Roseville, CA, 95661, United States of America, Andrew.Vakhutinsky@revionics.com

We formulate retail markdown optimization problem as mixed-integer linear programming problem, propose column-generation approach to solving it, and show how the problem can be decomposed when the budget constraints encompass large groups of products with very low demand transference between the groups. We discuss the results of our computational experiments with real data.

■ TB21

Level 2 - Room 206

Capacity Planning and Scheduling for the Care of the Elderly

Sponsor: Health Applications

Sponsored Session

Chair: Jonathan Patrick, Telfer School of Management, University of Ottawa, 55 Laurier Avenue East, Ottawa, ON, K1N 6N5, Canada, patrick@telfer.uottawa.ca

1 - Whole-System Patient Flow Simulation Model

Ali Esensoy, PhD Student, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, ali.esensoy@utoronto.ca, Michael Carter

Cross-sector patient flow model is a system dynamics simulation focused on the flow rates of patients between health system sectors, and the feedback structures around them. It takes a whole-system, strategic perspective, and is designed to produce output that captures the direction and magnitude resulting from policy changes around patient pathways and service levels. We discuss our development process, the model components and examples of policy analyses conducted using the final simulation.

2 - Capacity Planning for Publicly Funded LTC in the U.S.

Yan Li, West Lafayette, IN, United States of America, li528@purdue.edu, Nan Kong, Mark Lawley, Laura Sands

Long-term care refers to the services provided to chronically ill or disabled people, many of whom are older adults whose only funding source is public programs. It remains unclear what capacity is needed for balancing the services provided in home-based facilities and nursing home centers. In this work, we formulate a parameter optimization problem with ODE constraints. We conduct case studies on dementia patients and perform extensive sensitivity analysis to draw managerial insights.

3 - Patient-centered Long-term Care Network Design

Paul Intrevado, Desautels Faculty of Management, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A1G5, Canada, paulintrevado@mac.com, Vedat Verter

A dynamic co-location, capacity acquisition and patient assignment model for long-term care facilities is presented as a mixed-integer program, capturing patient quality-of-life. An illustrative example based on empirical data is presented and results discussed.

4 - Modeling the Community Care Services for Alternate Level of Care (ALC) Patients: A Queuing Network Approach

Pedram Noghani, MSc student, University of Ottawa, Unit 929- 2660 Norberry Crescent, Ottawa, ON, k1v6n2, Canada, pedram.noghani@gmail.com

In this study, we try to model the alternative level of care (ALC) patients flow to show the effect of downstream capacities on number of ALC patients and their length of stays in acute care facilities. We develop queuing network model to capture patients flow using a heuristic approximation method to find the steady state parameters of the model.

■ TB22

Level 2 - Room 207

Joint Session Disease Pro/DM: Proteomic and Genomic Analysis of Human Diseases

Cluster: Disease Progression & Data Mining

Invited Session

Chair: Munevver Mine Subasi, Assistant Professor, Florida Institute of Technology, Department of Mathematical Sciences, 150 W. University Blvd, Melbourne, FL, 32901, United States of America, msubasi@fit.edu

1 - A Classification Model to Predict the Progression of Chronic Kidney Disease

Ersoy Subasi, Assistant Professor, Embry-Riddle Aeronautical University, Department of Mathematics, 600 S. Clyde Morris Blvd., Daytona Beach, FL, 32114, United States of America, subasie@erau.edu, Munevver Mine Subasi, Michael Lipkowitz

We use Logical Analysis of Data, a sophisticated and robust classification method based on the theory of Boolean functions, optimization, and combinatorics, to analyze the clinical and proteomics chronic kidney disease (CKD) data collected as part of the African American Study of Kidney Disease & Hypertension. The goal of our study is to identify combinatorial biomarkers (combination of highly influential clinical and serum proteomic features) that accurately predict the progression of CKD.

2 - A New Multi-class Classification Method and Its Application to Medicine

Juan Felix Avila-Herrera, Universidad Nacional and Universidad de Costa Rica, Costa Rica, delagarita@hotmail.com, Munevver Mine Subasi, Michael Lipkowitz

Logical Analysis of Data (LAD) is a two-class classification method which integrates principles of combinatorics, optimization, and the theory of Boolean functions. We propose an algorithm based on mixed integer linear programming (MILP) to extend the LAD methodology to solve multi-class classification problems. We apply the proposed approach on a real-world chronic kidney disease proteomic dataset to build multi-class classification models that predict the progression of the renal disease.

3 - A Network Flow Approach to Select Significant Patterns in Large-scale Data Analysis

Munevver Mine Subasi, Assistant Professor, Florida Institute of Technology, Department of Mathematical Sciences, 150 W. University Blvd, Melbourne, FL, 32901, United States of America, msubasi@fit.edu, Juan Felix Avila-Herrera

Current implementations of Logical Analysis of Data (LAD) use greedy-type heuristics to select patterns to form a classification model. We present a network flow based approach to identify significant patterns to generate an LAD model. Our approach allows the user-specified requirements such as statistical significance, Hamming distance, homogeneity, hazard ratio and/or prevalence of patterns. We present experiments on benchmark datasets to demonstrate the utility of the proposed method.

■ TB23

Level 2 - Room 208A

Dynamic Pricing and Assortment Optimization with Limited Information

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Bora Keskin, University of Chicago, Chicago, IL, United States of America, bora.keskin@chicagobooth.edu

1 - A Markov Chain Approximation to Choice Modeling

Guillermo Gallego, Columbia University, 500W 120th St., New York, NY, United States of America, gmg2@columbia.edu

We present a new choice model that is a simultaneous approximation for all random utility based discrete choice models including the multinomial logit, the probit, the nested logit and mixtures of multinomial logit models. Our model is based on a new primitive for substitution behavior where substitution from one product to another is modeled as a state transition of a Markov chain. We show that the choice probabilities computed by our model are a good approximation to the true choice probabilities for any random utility based choice model under mild conditions (exact for the MNL). We also show that assortment optimization can be solved in polynomial time. Numerical observations suggest that the average maximum relative error is less than 3%.

2 - Dynamic Pricing Without Priors

Rene Caldentey, New York University, Stern School of Business, 44 West Fourth Street, New York, United States of America, rcaldent@stern.nyu.edu, Ying Liu, Ilan Lobel

We consider the pricing problem faced by a monopolist selling to a population of consumers over a discrete-time horizon. Customers are heterogeneous along two dimensions: (1) willingness-to-pay and (2) arrival time. The seller has limited information about demand, knowing only the support of customers' valuation. We characterize a robust pricing policy, which minimizes the seller's regret defined as the difference between her payoff under full demand information and her realized payoff.

3 - Estimating Willingness-to-Pay and Willingness-to-Sell from Negotiation Data

A. Serdar Simsek, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, ASimsek13@gsb.columbia.edu, Garrett van Ryzin, Robert Phillips

We develop a structural estimation method based on the Expectation-Maximization algorithm to estimate willingness-to-pay (WTP) and willingness-to-sell (WTS) distributions. The data consist only of whether or not trade takes place, if it does, the negotiated price. Our method provides accurate estimates when applied to both synthetic and real data sets. We also show how the WTP and WTS estimates can be used to improve revenues for the seller by optimally setting reserve prices on negotiations.

4 - Chasing Demand: Pricing and Learning in a Changing Environment

Bora Keskin, University of Chicago, Chicago, IL, United States of America, bora.keskin@chicagobooth.edu, Assaf Zeevi

We consider a dynamic pricing problem in which a seller faces an unknown demand model that can change over time. We measure the amount of change over the time horizon using a suitable metric, and allow a finite "budget" for such changes. We first derive a lower bound on the expected performance gap between any pricing policy and a clairvoyant who knows the temporal evolution of the underlying demand model up front. Then, we design a pricing policy that (asymptotically) matches said lower bound.

■ TB24

Level 2 - Room 208B

Topics in Dynamic Pricing and Mechanism Design

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Roger Lederman, IBM Research, Yorktown Heights, NY, United States of America, rdlederm@us.ibm.com

1 - Revenue Maximization using Dynamic Mechanism Design with Two-dimensional Buyers and Type Uncertainty

Chaitanya Kaligotla, PhD Student, INSEAD, INSEAD Europe Campus, Boulevard de Constance, Fontainebleau, 77305, France, Chaitanya.KALIGOTLA@insead.edu

I study a decision problem to maximize seller revenue under two-dimensional buyer space with private information. I consider the general case of a single seller with a single good to sell to buyers with private attribute values arriving over 2 time periods. I use dynamic mechanism design theory to find an incentive compatible mechanism for the seller. I investigate structural conditions for the optimal seller policy.

2 - Dynamic Pricing of Software as a Service in Subscription Markets

Nabita Penmetsa, Doctoral Candidate, University of Pittsburgh, Joseph M.Katz Graduate School of Busines, Mervis Hall, Pittsburgh, PA, 15260, United States of America, Npenmetsa@katz.pitt.edu, Esther Gal-Or, Jerrold May

We examine the dynamic pricing problem of a firm selling a new version of software on a subscription basis. Consumers know their valuation for the existing version but are not familiar with the features included in the new version and updates available during the subscription period. Assuming consumers can learn about their valuation after one usage occasion, we examine the dynamic pricing strategies that a monopolist can exercise when he can observe the purchase history of a consumer.

3 - Managing Time-of-Day Electricity Usage with Static and Dynamic Pricing Segments
Shivaram Subramanian, IBM Research, 1101 Kitchawan Road, TJ Watson Research Center, Yorktown Heights, United States of America, subshiva@us.ibm.com, Soumyadip Ghosh, Roger Lederman

We present a novel predictive-control approach that allows an electricity provider to monitor and proactively manage peak and off-peak residential intra-day electricity usage in an emerging smart energy grid using time-dependent dynamic pricing incentives. We develop a forecast model for intra-day shares of a total daily load, which is then embedded within a global optimization framework for managing the daily electricity usage.

■ TB25

Level 2 - Room 208C

Modeling Economic Markets

Cluster: Auctions

Invited Session

Chair: Adam Wierman, Professor, California Institute of Technology, 1200 E California Blvd MC 305-16, Pasadena, CA, 91125, United States of America, adamw@caltech.edu

1 - Bargaining with Middlemen
Randall Berry, Northwestern University, Evanston, IL, United States of America, rberry@ece.northwestern.edu, Thanh Nguyen, Vijay Subramanian

In this paper, we consider the dynamics and decentralized market modeled by a non-cooperative networked bargaining game. Our goal is to study how the network structure of the market and the role of middlemen influence the market's efficiency and the fairness. We introduce the concept of limit stationary equilibrium for a general trading network and use it to analyze how endogenous delay emerges in trade and how surplus is shared between sellers and buyers.

2 - Truthful Mechanisms for Knapsack Valuations
Thanh Nguyen, Northwestern University, 2001 Sheridan Road, Evanston, IL, United States of America, t-nguyen@kellogg.northwestern.edu, Rakesh Vohra, Hu Fu

We consider incentive compatible mechanisms for welfare maximization in combinatorial auctions when a bidder's valuation for a bundle of items is the solution to a knapsack problem. The valuations as well as the maximum total welfare are NP hard to compute. We design a near optimal, polynomial-time-computable truthful-in-expectation mechanism. We further apply this technique to a more general and natural setting.

3 - Goodness of Fit Measures for Revealed Preference Tests: Complexity Results and Algorithms
Frits Spieksma, KU Leuven, Leuven, Belgium, frits.spieksma@econ.kuleuven.be, Bram De Rock, Bart Smeulders, Laurens Cherchye

Utility maximization is a core hypothesis in neoclassical microeconomics, and testing the empirical validity of this assumption has attracted considerable attention in the literature. We provide results on the computational complexity of popular goodness-of-fit measures, such as Afriat's efficiency index, Varian's efficiency vector-index, and the Houtman-Maks index. These results explain the computational difficulties that have been observed in literature when computing these indices.

4 - The Empirical Implications of Complexity for Economic Models
Adam Wierman, Professor, California Institute of Technology, 1200 E. California Blvd MC 305-16, Pasadena, CA, 91125, United States of America, adamw@caltech.edu, Siddharth Barman, Umang Bhaskar, Federico Echenique

Recently, the task of understanding the complexity of economic models has received considerable focus. Results have emerged for a variety of models, and the general message is that economic models tend to be computationally hard in the worst case. This motivates the question of whether this complexity has empirical implications. In this work, we begin to address this question in the context of consumer choice theory and bimatrix games using tools from revealed preference theory.

■ TB26

Level 2 - Room 208D

Competitive Facility Location

Sponsor: Location Analysis

Sponsored Session

Chair: Tammy Drezner, Professor, California State University, 800 N. State College Blvd., Fullerton, CA, 92834, United States of America, tdrezner@fullerton.edu

1 - The Maximin HAZMAT Routing Problem
Vladimir Marianov, Professor, Pontificia Universidad Catolica de Chile, Department of Electrical engineering, Av. Vicuña Mackenna 4860, Santiago, 782 0436, Chile, marianov@ing.puc.cl, Andres Bronfman, Armin Luer-Villagra

We propose a model for maximizing the distance between a HAZMAT transportation route over a network and its closest vulnerable point (schools, hospitals, nursing homes) in an urban area. Although such a model would require a very large number of node-arc assignment variables and constraints, we manage to reduce them to a manageable amount. Computational experience is provided for a 1,521 arc, 504 node, 30 populated center network in Santiago, Chile.

2 - Asymmetric Location Competition
H. A. Eiselt, University of New Brunswick, Fredericton, NB, Canada, haeiselt@unb.ca, Vladimir Marianov

This presentation considers the standard Hotelling competitive model in which competitors follow different objectives. One of such cases would be a state run school in competition with private schools. We look at service levels to customers and different entry sequences: first public then private and first private then public.

3 - Budget Allocation Across Multiple Markets
Tammy Drezner, Professor, California State University, 800 N. State College Blvd., Fullerton, CA, 92834, United States of America, tdrezner@fullerton.edu, Pawel Kalczynski, Zvi Drezner

An investment decision in several mutually-exclusive market areas is to be made. These models can be markets in cities around the globe or markets far enough from one another. An illustrative example problem of 20 markets with a total of 400 facilities, 4,800 potential locations for new facilities, and 5,000 demand points is optimally solved in less than 2 hours of computing time.

4 - The Quintile Share Ratio in Location Analysis
Zvi Drezner, Professor, California State University, Dept. ISDS, Fullerton, CA, 92834, United States of America, zdrezner@fullerton.edu, Tammy Drezner, Beat Hulliger

The inequality measure "Quintile Share Ratio" (QSR or sometimes S80/S20) is the primary income inequality measure in the European Union's set of indicators on social cohesion.It is the ratio of total income received by the 20% of the population with the highest income (top quintile) to that received by the 20% of the population with the lowest income (lowest quintile). Problems with 100,000 demand points are optimally solved in an average time of less than 40 seconds.

■ TB27

Level 2 - Room 209A

Military Operations Research using Social Science Methodologies

Sponsor: Military Applications

Sponsored Session

Chair: David Arney, United States Military Academy, Department of Mathematics, West Point, NY, United States of America, david.arney@usma.edu

1 - Operations Research and Network Science Forming a Modern, Emerging Conception of Information
David Arney, United States Military Academy, Department of Mathematics, West Point, NY, United States of America, david.arney@usma.edu, Kathryn Coronges

Progress is being made in solving problems and understanding issues in our information-centric world to build systems and make decisions. This progress comes from integrating modes of understanding (theory, application, and practice) and perception (data, information, intelligence, knowledge, and wisdom). Operations research and network science play a role. Our model focuses on these two disciplines for information problem solving and informatics.

2 - Optimizing Counterinsurgency Operations
Marvin King, Operations Research Analyst, US Army, 24025 High Meadow Dr., Golden, CO, 80401, United States of America, Marvking3@gmail.com, Alexandra Newman

We present a model that uses historic casualty information on counterinsurgents and insurgents, allied military force strengths, and economic data with modern counterinsurgency theories to aid in the estimate of force requirements for ongoing and future counterinsurgency campaigns. Our mathematical optimization model provides insights that allow the military and government to make more informed decisions regarding the number of forces to deploy in future conflicts.

3 - Operations Research and Network Science through Minerva's Social Science Lens
Kathryn Coronges, United States Military Academy, Department of Behavioral Sciences, West Point, United States of America, kathryn.coronges@usma.edu, David Arney

Today's military is based on information processing for decision making. No longer are operations always won by the most powerful, but rather victory often goes to the information dominant, culturally-aware, net-centric force. Minerva seeks to understand the cultural, social, and behavioral dynamics that shape military operations. Our Minerva framework takes an interdisciplinary approach that require operations research analysis, network modeling, and social science perspectives.

■ TB28

Level 2 - Room 209B

Optimization Issues in Cloud Computing

Cluster: Cloud Computing

Invited Session

Chair: Yingdong Lu, IBM T.J. Watson Research Center, 1101 Kitchawan Rd., Yorktown Heights, NY, United States of America, yingdong@us.ibm.com

1 - Pricing of Service in Clouds: Optimal Response and Strategic Interactions
Uday Shanbhag, Pennsylvania State University, 353 Leonhard Building, University Park, PA, 16802, United States of America, udaybag@engr.psu.edu, Cheng Wang, George Kesidis, Bhuvan Urgaonkar

Cloud providers are faced by a diversity of pricing structures to discourage high demands or mitigate volatility. In the context of tiered and tail-based pricing structures, we examine the optimal responses of consumers in non-strategic as well as strategic regimes where payoffs across consumers may be coupled by a coincident peak tariff. We further investigate the optimal design of the prescribed pricing structures in such settings. The results are supported by some preliminary numerics.

2 - Big Data Analysis
Li Zhang, IBM, Yorktown Heights, NY, United States of America, zhangli@us.ibm.com

We study various issues of performance and control in a big data framework.

3 - Provisioning for Cloud Computing Services via Non-parametric Adaptive Learning
Yue Tan, PhD Candidate, The Ohio State University, 210 Baker Systems Bldg., 1971 Neil Ave., Columbus, OH, 43210, United States of America, tan.268@buckeyemail.osu.edu, Cathy Xia

The high volatility nature of the emerging cloud computing service market makes service demand highly uncertain. The traditional provisioning solutions employing classical demand estimation approaches can hardly guarantee convergence to the optimal offering. In our study, we present a non-parametric adaptive learning approach that provides much improved offering solutions. This learning approach could be used to calibrate the model and converge to the optimal.

4 - Large-scale Distributed Optimization in Deep Learning
Rajat Monga, Google, 1600 Amphitheatre Parkway, Mountain View, CA, United States of America, rajatmonga@google.com

Biologically inspired deep learning models have been achieving state of the art results in areas such as vision and speech and language. We have trained large models (with over 1 billion parameters) utilizing clusters of thousands of machines by leveraging model and data parallelism. In this talk I'll describe two optimization methods that have been key to achieving these results (i) asynchronous stochastic gradient descent, and (ii) a large batch optimization procedure using L-BFGS.

■ TB29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Imagine That, Inc. - ExtendSim Simulation Software
Dave Krahl, Technology Evangelist, Imagine That, Inc., 6830 Via Del Oro, Ste. 230, San Jose, CA, 95119, United States of America, davek@extendsim.com

Experience the ease at which robust, intuitive models are built with the power tool for simulation - ExtendSim. Use custom interactive model interfaces and hierarchical submodels to rapidly explore simulation concepts and design options. Use ExtendSim to achieve your modeling objectives rapidly and be assured success.

2 - GAMS Development Corporation - Model Building and Deployment with GAMS
Steve Dirkse, Director of Optimization, GAMS Development Corp., 1217 Potomac St. NW, Washington, DC, United States of America, sdirkse@gams.com

We demonstrate many of the capabilities of the GAMS software as we start with a simple optimization model and build it out by adding nonlinear and integer variables to the model and connecting it with a GUI in a sample application.relationships influence firm performance.

■ TB30

Level 2 - Room 210B

Continuous Optimization

Contributed Session

Chair: Mehdi Behroozi, University of Minnesota, 111 Church St., SE, Department of Industrial and Systems Eng, Minneapolis, MN, 55455, United States of America, behro040@umn.edu

1 - Estimating Gradient using Perceptron for Constrained Minimization with Application in Drag Reduction
Burak Kocuk, Research Assistant, Georgia Institute of Technology, Industrial & Systems Engineering, 765 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, burak.kocuk@gatech.edu, Kuban Altinel, Necati Aras

We consider the minimization of a function whose closed-form is unknown, subject to well-defined constraints with the assumption that there is available data to train a perceptron, which can be used to estimate the gradient of the objective function. This estimate is combined with the gradients of the constraints so that a variant of the reduced gradient method can be applied to solve a list of benchmark problems. An interesting application of the new method in drag reduction is also provided.

2 - The Use of Decomposition Principle for Discrete Conditional Moment Problems
Mariya Naumova, Rutgers University, 640 Bartholomew Rd., Piscataway, NJ, 088854, United States of America, mnaumova@rci.rutgers.edu

We propose a new framework for bounding the expectation of a discrete random variable. The bounds are based on the knowledge of some of the power moments as well as conditional moments of the random variables. The discrete conditional moment bounding problems (DCMP) are formulated as LP's with special structures and can be solved using Dantzig-Wolfe decomposition by the used of the Discrete Moment Problem (DMP).

3 - Geographic Partitioning and Robust Network Design
Mehdi Behroozi, University of Minnesota, 111 Church St., SE, Department of Industrial and Systems Eng, Minneapolis, MN, 55455, United States of America, behro040@umn.edu, John Carlsson, Xiang Li

We present fast approximation algorithms for the problem of dividing a given convex geographic region into smaller sub-regions so as to distribute the workloads of a set of vehicles. Our objective is to partition the region in such a fashion as to ensure that vehicles are capable of communicating with one another under limited communication radii. We consider variations of this problem in which sub-regions are constrained to be convex or to have equal area.

4 - Some Comments on Discrete Sequential Search with Group Activities
Roel Leus, Professor, KU Leuven, Naamsestraat 69, Leuven, 3000, Belgium, Roel.Leus@kuleuven.be, Kris Coolen, Fabrice Talla Nobibon

We comment on a paper by Wagner and Davis (Decision Sciences, 2001), who present an IP-model for a single-item discrete sequential search problem with so-called 'group activities'. They conjecture that the problem can be solved as a linear program. We provide a counterexample for this conjecture, we show that the problem is strongly NP-hard both for 'conjunctive' as well as for 'disjunctive' group activities, and we discuss some special cases that can be solved in polynomial time.

■ TB31

Level 2 - Room 211A

Analytic Methods in Quantitative Finance

Sponsor: Financial Services

Sponsored Session

Chair: Rafael Mendoza-Arriaga, Assistant Professor, University of Texas at Austin, IROM, CBA 5.202, Austin, TX, 78712, United States of America, Rafael.Mendoza-Arriaga@mccombs.utexas.edu

1 - Variance Swaps on Time-changed Markov Processes
Matthew Lorig, Princeton University, 5 Lincoln Ct, Princeton, NJ, United States of America, mlorig@princeton.edu, Roger Lee, Peter Carr

We prove that the variance swap rate is just the price of a co-terminal European-style contract when the underlying is modeled as an exponential Markov process, time-changed by an arbitrary continuous stochastic clock. The payoff function of the European contract that prices the variance swap satisfies an ordinary integrodifferential equation, which depends only on the dynamics of the Markov process, not on the clock.

2 - Continuous and Discrete Time Stochastic Control
Daniel Mitchell, University of Texas, McCombs School of Business, Austin, TX, United States of America, daniel.mitchell@phd.mccombs.utexas.edu, Kumar Muthuraman

We study a stochastic process in which a controller has the opportunity to issue control in continuous time at some cost. Additionally the controller can issue control for a different cost at discrete time intervals. We find an algorithm to solve for the optimal control and discuss applications in portfolio management.

3 - Binomial Method for Optimal Portfolio Liquidation
Jingnan Chen, University of Illinois at Urbana-Champaign, Champaign, IL, United States of America, jchen98@illinois.edu, Liming Feng, Jiming Peng

We consider the optimal execution of assets where the objective is to minimize trading cost and risk. Two types of risk criteria, quadratic variation and value-at-risk, are taken into account. We propose a binomial method to obtain the optimal trading strategy numerically. The effect of some factors, such as price impact and correlation between assets, are analyzed.

4 - Inverse Subordinators and Their Applications in Financial Modeling
Yutian Nie, Northwestern University, 2145 Sheridon Rd., Evanston, IL, 60208, United States of America, YutianNie2016@u.northwestern.edu, Vadim Linetsky

We investigate a class of stochastic processes called inverse subordinators, i.e., hitting time processes of increasing Levy processes. They are generally non-Markovian semimartingales that can be embedded in two-dimensional Markovian processes. We show their long range dependence (LRD) property and propose a two-factor model based on Levy processes time changed with inverse subordinators. We obtain analytical solutions for European options via Fourier inversion and Hilbert transform methods.

■ TB32

Level 2 - Room 211B

Technology Management Section Best Paper Winner Presentation

Sponsor: Technology Management

Sponsored Session

Chair: Leonardo Santiago, Associate Professor, Federal University of Minas Gerais, Escola de Engenharia da UFMG, Av. Antônio Carlos, 6627 - Pampulha, Belo Horizonte, MG, 31270-901, Brazil, lsantiago@ufmg.br

1 - Is the Tendency to Engage in Entrepreneurship Genetic?
Nicos Nicolaou, University of Cyprus & Cass Business School, City University London, Department of Business Administration, P.O.Box 20537, Nicosia, 1678, Cyprus, nicos.nicolaou@ucy.ac.cy, Scott Shane

Perhaps the most common question that practitioners ask about entrepreneurship is "Are entrepreneurs born or made?' Unfortunately, despite more than 50 years of research, scholars have only recently tried to provide an answer to this question. This paper reviews the recent findings on the genetics of entrepreneurship. It examines the evidence for the effect of genes on the tendency to engage in entrepreneurial activity and outlines the direction of future research in this area.

2 - Entrepreneurial Technology Commercialization Strategies: Past and Future Research
David Hsu, Wharton School, University of Pennsylvania, 3620 Locust Walk, 2028 SHDH, Philadelphia, PA, 19104, United States of America, dhsu@wharton.upenn.edu, Scott Stern, Joshua Gans

We review our article, "The Impact of Uncertain Intellectual Property Rights on the Market for Ideas: Evidence from Patent Grant Delays," published in Management Science in 2008. After reflecting on the article, we examine the follow-on work, and conclude by discussing future avenues for research in this domain.

■ TB33

Level 2 - Room 211C

Risk and Uncertainty in Homeland Security

Cluster: Homeland Security/Defense

Invited Session

Chair: Chase Murray, Auburn University, Industrial & Systems Engineering, Auburn, AL, United States of America, ccm0022@auburn.edu

1 - Optimal Search under Evolving Uncertainty
Jesse Pietz, Naval Postgraduate School, 1411 Cunningham Road, Monterey, CA, 93943, United States of America, japietz@nps.edu, Johannes O. Røyset

We consider the problem of optimal search where environmental conditions can impact the effectiveness of the search plan. We use a multi-period model to task search assets over multiple mission cycles. Assuming time-phased weather reporting, we use a multi-stage stochastic program to compute optimal solutions which account for evolving environmental uncertainty by recommending scenario-based search plans.

2 - Routing of Autonomous UAVs in Unmapped Environments
Chase Murray, Auburn University, Industrial & Systems Engineering, Auburn, AL, United States of America, ccm0022@auburn.edu

Unmanned aerial vehicles (UAVs) have become increasingly capable and affordable. In this talk, we detail how to "easily" modify a commercial off-the-shelf (COTS) UAV to perform obstacle avoidance. We also describe algorithms that use real-time obstacle detection to enable autonomous flight in unmapped, GPS-denied regions (e.g., inside buildings or caves). Algorithm performance is demonstrated for the case of a single UAV. Challenges of extending this work to multiple UAVs are also discussed.

■ TB34

Level 2 - Room 211D

Advances in Optimization via Simulation

Sponsor: Simulation Society

Sponsored Session

Chair: Jie Xu, Assistant Professor, George Mason University, 4400 University Dr, MS 4A6, Fairfax, VA, 22030, United States of America, jxu13@gmu.edu

1 - Bayesian Optimization via Simulation with Pairwise Sampling and Correlated Prior Beliefs
Jing Xie, Cornell University, Ithaca, NY, United States of America, jx66@cornell.edu, Peter Frazier, Stephen E. Chick

We allow for both a correlated prior distribution on the means (e.g., with kriging models) and sampling correlation (e.g., with CRN) in discrete optimization via simulation. These two correlations are brought together for the first time in a highly-sequential knowledge-gradient sampling algorithm, which chooses points to sample using a Bayesian value of information criterion, and lead to improved optimization performance in problems with a combinatorial number of alternatives and costly samples.

2 - Population Model-based Optimization
Xi Chen, PhD Student, University of Illinois at Urbana-Champaign, 205 Transportation Bldg., 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, xchen37@illinois.edu, Enlu Zhou

Model-based methods are effective for solving optimization problem with little structure. To better capture the multi-modality of the objective functions than traditional model-based methods which use only a single model, we propose a framework of using a population of models with an adaptive mechanism to propagate the population. The mechanism is derived from estimating the optimal parameter of the model in a Bayesian manner, which provides a proper way to determine the diversity of the models.

3 - Constrained Simulation Optimization on Integer-ordered Spaces
Raghu Pasupathy, Associate Professor, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, pasupath@vt.edu, Kalyani Nagarajan

We will present a simple extension to the algorithm R-SPLINE for constrained simulation optimization on integer-ordered spaces. The algorithm involves generating and solving a sequence of sample-path problems that include both objective and constraint function estimators. Asymptotic results on consistency, feasibility, and convergence rates will be discussed. If time permits, we will present some numerical results.

4 - Improving Performance of Penalty Function with Memory by Approximate Simulation Budget Allocation
Chuljin Park, Ph.D. candidate, Georgia Institute of Technology, 765 Ferst Dr, Atlanta, GA, 30332, United States of America, cpark41@gatech.edu, Seong-Hee Kim

Penalty function with memory (PFM) has been proposed to handle stochastic constraints in discrete optimization via simulation (DOvS). In this talk, we revise an approximate simulation budget allocation method due to Lee et al. (2012) and improve the performance of PFM by combining it with the revised budget allocation method. Convergence properties of the combined DOvS algorithms are discussed and empirical results are provided on three test problems.

■ TB35

Level 2 - Room 212A

Energy Information Systems

Sponsor: E-Business

Sponsored Session

Chair: Wolf Ketter, Associate Professor, Erasmus University, Rotterdam School of Management, Rotterdam, Netherlands, WKetter@rsm.nl

1 - Autonomous Retail Electricity Trading: Strategies and Economic Benefits
Markus Peters, PhD Candidate, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, peters@rsm.nl, Wolf Ketter, John Collins

Sustainable energy systems need new forms of coordinating between demand and supply from renewable and traditional sources. The Power TAC platform helps researchers understand the dynamics of retail electricity markets, and it provides a laboratory for testing new coordination strategies. We analyze strategies proposed by the Power TAC community, give insights into success factors for competitive retail electricity markets, and take steps towards a design theory for retail electricity brokers.

2 - Smart Charging of Electric Vehicles using Intelligent Software Agents
Konstantina Valogianni, PhD Candidate, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, kvalogianni@rsm.nl, John Collins, Wolf Ketter

The introduction of Electric Vehicles in the existing Energy Grid raises many issues regarding energy Grid's stability. We examine the effect of EVs introduction in the energy grid. We model the driving profiles and charging attitude of the individuals. We prove that there exist economic benefits for individuals who are more risk taking compared to the risk averse ones. Finally, we propose a smart charging strategy that improves the social welfare and enhances grid's stability and reliability.

3 - A Learning Agent for Heat-pump Thermostat Control
Daniel Urieli, PhD Candidate, The University of Texas at Austin, 2317 Speedway, Stop D9500, Austin, TX, United States of America, urieli@utexas.edu, Peter Stone

HVAC systems are a major energy consumer around the world. Heat-pump based HVAC systems have gained popularity due to their high efficiency. We describe a learning, adaptive agent that controls a heat-pump thermostat. Our agent reduces 7%-15% of the system's yearly energy consumption, comparing to the strategy that is deployed in practice, while meeting the occupants' comfort requirements. Our agent is fully implemented and tested in the GridLAB-D simulation environment.

■ TB36

Level 2 - Room 212B

Planning for Health and Humanitarian Response

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: David Hutton, Professor, University of Michigan, 1420 Washington Heights, Ann Arbor, MI, United States of America, dwhutton@umich.edu

1 - Strategic Health Workforce Planning: Modeling, Optimality, and Uncertainty
Weihong Hu, University of Southern California, 3715 McClintock Avenue, GER 240, Los Angeles, 90089-0899, United States of America, weihongh@usc.edu, Mariel Lavieri, Alejandro Toriello, Xiang Liu

We propose an infinite-horizon linear programming model for workforce planning in a large health system for a single worker class. We prove the optimality of a natural look-ahead policy applicable to any system of this kind, and use real-world data to examine the performance of the policy in more complex systems with additional detail. The results motivate us to further analyze the impact of demand uncertainty.

2 - Humanitarian Staff Reassignment: Introducing 'Almost Acceptable' Complete Stable Matchings
Mallory Soldner, PhD Candidate, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, msoldner@gatech.edu, Ozlem Ergun, Julie Swann

Humanitarian organizations regularly face the challenge of reassigning staff members to different positions. To bridge the gap between incomplete matchings and the requirement of continuing employment for all employees and covering all positions, we introduce models to adapt the widely accepted and implemented stable matching framework. We seek minimal modifications to agent preferences to achieve complete matchings, while maintaining that the final result meets stability properties.

3 - Examining Policies for Pandemic Influenza Targeted to Age Groups and Those with Comorbid Conditions
David Hutton, Professor, University of Michigan, 1420 Washington Heights, Ann Arbor, MI, United States of America, dwhutton@umich.edu, Yoshi Gillaspie, Nayer Khazeni

Current pandemic and seasonal influenza mitigation plans target age groups and those with comorbid conditions. Due to complexities and uncertainties surrounding pandemic influenza, mathematical models are needed to answer policy questions. We discuss the construction of a pandemic influenza model that incorporates both age and comorbidities in a population. We examine the impact of targeting various interventions to specific age and comorbid groups.

4 - Measuring Humanitarian Response Capacity
Jason Acimovic, Pennsylvania State University, 462 Business Building, State College, PA, 16802, United States of America, acimovic@psu.edu, Jarrod Goentzel

Preparedness efforts for natural or man-made disasters often include prepositioning key relief items in strategic locations. Aid organizations must determine the overall investment for each product and the allocation of inventory among depots. We develop a model that measures the capacity to respond to a disaster and the quality of the inventory allocation. We test the model using historical data on disaster-affected populations and stock levels from United Nations depots.

■ TB37

Level 2 - Room 213A

Managing Complex Projects

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Ted Klastorin, Professor, University of Washington, Box 353226, Foster School of Business, Seattle, WA, 98195-3226, United States of America, tedk@u.washington.edu

1 - Managing New Product Development Projects in the Presence of a Competitive Threat

Issariya Sirichakwal, University of Washington, 423 Paccar Hall, Seattle, WA, 98195-5852, United States of America, issars@u.washington.edu, Theodore Klastorin, Gary Mitchell

We consider the introduction of a new product or service where the innovator firm faces competition to the market and it only knows a distribution representing the market entry time of a possible rival. The first firm to enter the market is rewarded with a single payment or a per period monopoly profit. We consider the trade-off between the development cost and the risk of a rival entering the market first, and provide insights into managing the internal activities of the development projects.

2 - Incentive Contracts in Sequential Projects

Tony Chen, University of Washington, Box 353200, Foster School of Business, Seattle, WA, 98195-3226, United States of America, tony0906@uw.edu, Michael Wagner, Ted Klastorin

We investigate how incentive contracts and delayed payment terms affect a contractor's decision when managing a large scale sequential project which is outsourced to n independent subcontractors. Our paper provide efficient linear time algorithms for the contractor to find optimal decision variables and explains how these contract can lead to undesired results when misused.

3 - Incentive Alignment and Coordination of Project Supply Chains

Shi Chen, Stanford University, 84 Hulme Court, Apt. 109, Stanford, CA, 94305, United States of America, shichen@stanford.edu, Hau L. Lee

This study addresses the incentive and coordination problem in project supply chains. We find that common contracts with simple contract terms lead to misalignment of incentives; we show that a more sophisticated but implementable contract, the delivery-schedule-based contract, can coordinate the supply chains if one properly sets up contract terms. We also show that the manufacturer should focus more on the information accuracy of the volatility rather than the duration of the supply lead time.

■ TB38

Level 2 - Room 213B

Multicriteria Optimization and Decision Making

Contributed Session

Chair: Alexander Engau, Assistant Professor, University of Colorado Denver, 1250 14th Street, Suite 600, Denver, CO, 80202, United States of America, aengau@alumni.clemson.edu

1 - Customer Portfolio Optimization: Marketing Resource Allocation under Uncertainty

Michael Haydock, Partner, Chief Scientist, IBM, 6460 Fox Path, Chanhassen, MN, 55317, United States of America, haydockm@att.net, Marc Teerlink

Efforts in the marketing sciences can be distinguished between the analysis of individual customers and the examination of portfolios of customers. Despite enormous gains within the marketing discipline in understanding and predicting customer buying behavior, the optimal allocation of marketing investments across customer groups is a challenging area not well understood by marketing practitioners. This session details three case studies of large US based enterprises.

2 - A Multi-objective Approach for Transboundary River Water Allocation

Reza Roozbahani, PhD Student, RMIT University, 360 Swanston Street, Melbourne, VI, 3000, Australia, Reza.Roozbahani@RMIT.edu.au, Babak Abbasi, Sergei Schreider

Water allocation of transboundary rivers is a complicated issue that involves conflicting objectives. This paper proposes a multi-objective model to solve this issue. Each objective function of the model represents a stakeholder's revenue from allocated water; which needs to be maximized. A new solution method for the model is proposed. The solution ensures that each stakeholder's profit is more than a percentage of its maximum possible profit where the percentage is equal for all stakeholders.

3 - Decision Strategy Choosing in Large Decision Table via Risk Preferences and Criteria Reduction

Jian Liu, Assistant Professor, Nanjing University of Science and Technology, 200 Xiaoling Wei St., Nanjing, 210094, China, jianlau7550@gmail.com, Si-feng Liu, Peng Liu

Two decision strategies are proposed to address the "large decision table" (e.g. a large number of criteria) challenge in multi-criteria decision making. One: find useful criteria based on tolerance relationship then use different risk preference (RP) models to find the best choice corresponding to the RP of decision makers (DMs). Two: classify DMs into three types according to their RP, use different RP models find useful criteria based on advantage relationship and get the best alternative.

4 - Unified Multicriteria Framework for Robust-Stochastic Formulations of Optimization under Uncertainty

Alexander Engau, Assistant Professor, University of Colorado Denver, 1250 14th Street, Suite 600, Denver, CO, 80202, United States of America, aengau@alumni.clemson.edu

We present new findings from using multicriteria approaches for robust and stochastic optimization. Based on the concept of efficiency under uncertainty, we first show how our unified framework includes several standard formulations as special case. We then summarize our recent technical results for general discrete or continuous random variables over bounded or unbounded supports, that provide new insight into advantages and remaining limitations of modeling uncertainty using multiple criteria.

■ TB39

Auditorium 3

Train Timetabling, Train Routing, and Railway Capacity Analysis

Sponsor: Railway Applications

Sponsored Session

Chair: Matthew Petering, Assistant Professor, University of Wisconsin Milwaukee, 3200 North Cramer St., EMS E367, Milwaukee, WI, 53211, United States of America, mattpete@uwm.edu

1 - Scheduling and Recovering from Disruptions in Rapid Transit Networks

Luis Cadarso, Technical University of Madrid, Pza. Cardenal Cisneros, 3, Madrid, 28040, Spain, luis.cadarso@upm.es

Rapid transit systems are highly complex systems. They are characterized by high frequencies and short distances. Their planning and operational processes are fields rich in combinatorial optimization problems. We develop timetable planning, rolling stock assignment, train routing, and integrated recovery models in order to determine robust schedules and recovery plans for disruption management. We report our computational tests on realistic problem instances of the Spanish rail operator RENFE.

2 - Railway Network Train Pathing by Timed or Physical Block Headway

Steven Harrod, Assistant Professor, University of Dayton, 1143 Ashburton Dr., Dayton, OH, 45459, United States of America, a2soft@aol.com, Thomas Schlechte

Two commonly used modeling methods for railway train path scheduling or timetabling are applied to identical problem sets and compared on performance measures such as solution time, value of solution, and accuracy of solution. The objective is to maximize the utility of the network, measured in train count and adherence to preferred timings. The model formulations are differentiated by whether they enforce timed separation of trains or physical separation of trains.

3 - The Öresund High-capacity Rail Corridor Standards

Hans Boysen, KTH Royal Institute of Technology, Stockholm, Sweden, heboysen@kth.se

The existing fixed link between Sweden and Denmark and the planned fixed link between Denmark and Germany have adopted a set of new infrastructure standards, which compared with the present limitations in the corridor enable three times higher cubic capacity and 60% higher tonnage per train, as well as higher freight train speeds. These factors, if also implemented on connecting lines in the corridor, will contribute to dramatically higher freight capacity in mixed traffic.

4 - Integer Programming for Cyclic Railway Timetabling and Routing on a Single Track Unidirectional Line

Matthew Petering, Assistant Professor, University of Wisconsin Milwaukee, 3200 North Cramer St., EMS E367, Milwaukee, WI, 53211, United States of America, mattpete@uwm.edu, Mojtaba Heydar, Dietrich Bergmann

We present a MILP model for cyclic train timetabling and routing along a single track, unidirectional railway line. The MILP model can handle (1) more than one siding per station, (2) more than two train types, and (3) different origins and destinations for each train type. Several heuristic and exact methods are employed in preliminary phases to set up the model, allowing CPLEX 12.4 to find optimal solutions to hundreds of large problem instances in a surprisingly short time.

■ TB40

Auditorium 2

TSL Dissertation/Thesis Award Winners

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Laurie Garrow, Georgia Institute of Technology, 790 Atlantic Drive, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu

1 - Award-winning Work of the Transportation Science and Logistics (TSL) Society

Laurie Garrow, Georgia Institute of Technology, 790 Atlantic Drive, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu

TSL 2013 Dissertation and Best Paper Prize winners will present their award-winning work in this session. Prize committee chairs will say a few words about the winning selections.

■ TB41

Level 1 -101A

Product Design and Strategy: Social and Supply Chain Considerations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Karthik Ramachandran, Assistant Professor, Georgia Institute of Technology, Scheller College of Business, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu

1 - Product Line Design with Strategic Customers and Co-production Manufacturing Technology

Saurabh Bansal, Pennsylvania State University, 405 Business Building, University Park, PA, United States of America, sub32@psu.edu, Karthik Ramachandran

We consider the product line design faced by firms who obtains various units simultaneously with random quality levels, and classify these units into different products based on the quality levels. All units of a product have quality levels greater than the tagged quality level. We investigate how this feature determines the product-line, and the contrast it to the traditional case where the quality of each unit is equal to the tagged quality.

2 - Reference Groups and Product Design

Jiong Sun, Illinois Institute of Technology, 10 West 35th Street, 18th Floor, Chicago, IL, 60616, United States of America, jsun22@iit.edu, Jinhong Xie, Tao Chen

Recent technological advances are creating unprecedented opportunities for consumer technology products to assume a new social function, representing users' social status, in addition to satisfying users' functional needs. We develop a model to study how such reference group effect may impact technology firms' product pricing, design, and targeting strategies in a setting of sequential introduction of upgraded product versions.

3 - Inter-temporal Product Line Strategies under Refurbishing of Consumer Returns

Narendra Singh, Ph.D. Candidate, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Narendra.Singh@scheller.gatech.edu, Ravi Subramanian, Karthik Ramachandran

We study product line decisions for a firm offering a new product in the first period and both new and refurbished products in the second period to strategic consumers. The refurbished products offered in the second period are from consumer returns of the new products sold in the first period. Under certain conditions, we find that the profit of the firm is non-monotone in the return rate.

4 - Complementary Product Innovations in Competitive Supply Chains

Ayhan Aydin, Assistant Professor of Information Systems and Operations Management, George Mason University, School of Management, 4400 University Dr, Fairfax, VA, 22030, United States of America, ayhan.aydin.us@gmail.com, Dan Adelman, Rodney Parker

Development of core (upstream) technologies by competitive industries depends on their diffusion in different downstream ones. Downstream firms may also need to invest to be able to use them. We investigate the effects of different industry and firm factors on the complementary R&D investments of two tiers of oligopolies. These investments improve the upstream technology and the final products' capabilities. We discuss which supply chain structures are more conducive to product innovations.

■ TB42

Level 1 -101B

Global Supply Chain

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Margaret Aksoy-Pierson, Tuck School of Business at Dartmouth, margaret.p.pierson@tuck.dartmouth.edu

1 - Managing Global Sourcing: Inventory Performance

Nitish Jain, INSEAD, Singapore, 138676, Singapore, nitish.jain@insead.edu, Karan Girotra, Serguei Netessine

Global Sourcing firms expose themselves to varied kind of disruptions such as extreme weather events, labor unrest and natural disasters. Firm supply chains that are resilient to such disruptions have an advantage. Using a novel data set of over 3.5 million import transactions by U.S. retailers, wholesalers, and manufacturers, we study role of sourcing strategies in fostering supply chain resilience.

2 - Manufacturing Sourcing in a Global Supply Chain: A Life Cycle Analysis

Shiliang Cui, Doctoral Student, The Wharton School, University of Pennsylvania, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, scui@wharton.upenn.edu, Morris Cohen

Today, while outsourcing to low-wage countries such as China continues to be a major component of global business strategy for large U.S. manufacturing companies, many have begun to rethink off-shoring of production to foreign locations. Why are firms placing such huge bets on "re-shoring"? To provide an answer, we propose to develop a modeling framework that will incorporate the major stages of a product's life cycle.

3 - Supply Chain Relationship Dependency, Relationship Strength, and Firm Performance

Marcus Bellamy, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta GA 30308, United States of America, marcus.bellamy@scheller.gatech.edu, Soumen Ghosh, Manpreet Hora

We investigate the dependency and strength of supply chain relationships and their association with firm performance. We develop and test hypotheses based on a unique dataset of supplier and customer relationships. Results from our empirical analysis suggest that the dependency and strength of supply chain

■ TB43

Level 1 -101C

Risk Driven Optimization of Supply Chain and Logistics Systems

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Retsef Levi, Massachusetts Institute of Technology, 100 Main St., E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

1 - Scheduling with Testing

Yaron Shaposhnik, Operations Research Center, MIT, 77 Massachusetts Avenue, Bldg. E40-149, MIT, Cambridge, MA, 02139, United States of America, shap@mit.edu, Retsef Levi, Thomas Magnanti

We study a new class of scheduling problems, where job lengths are a priori stochastic. The scheduler can use machine time to test jobs and gain better information on the respective lengths. This captures a common practical tradeoff of allocating resources between diagnostic that improves information and allows better scheduling, and doing work. We use a new cost-accounting scheme to characterize properties of optimal policies and devise a surprisingly low dimensional DP formulation and FPTAS.

2 - Managing Quality Risk and Shortage Risk in Outsourcing

Joline Uichanco, Massachusetts Institute of Technology, Cambridge, MA, United States of America, uichanco@mit.edu, Retsef Levi, Georgia Perakis

We study availability and quality risk tradeoffs involved in outsourcing. The problem is to decide on a supplier base and quantity purchased from each supplier, as well as a level of quality assurance (QA). The goal is to balance purchasing, shortage, defect and QA costs. We develop a tractable algorithm for the supplier selection problem which converges to the optimal solution. For the selected suppliers, the firm will only establish a QA program if the batch size exceeds a threshold.

3 - Predicting Damage for Major Storms: A Data Driven Approach

Georgia Perakis, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, United States of America, georgiap@mit.edu, Mallik Angalakudati, Jorge Calzada, Vivek Farias, Matthieu Monsch, Anna Papush, Sean Whipple, Cheri Warren, John Williams, Jeremy Schein, Jonathan Gonynor

In the past few years the New England area has experienced severe weather storms that left thousands of homes without power for prolonged periods of time. Through collaboration with a major utility company, we present a model that forecasts damage caused by a storm. We build a data driven model that utilizes the interaction between properties of the electrical network and weather to predict damage. Its output feeds to an optimization model for contracting repair crews in advance of a storm.

■ TB44

Level 1 -101D

Rational Consumer Behavior and Operational Decision-making

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Robert Swinney, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, robert.swinney@duke.edu

1 - Optimizing Product Launches in the Presence of Strategic Consumers

Jigar Patel, New York University, 44 West 4th Street, KMC 8-152, New York, NY, 10012, United States of America, jigar@stern.nyu.edu, Ilan Lobel, Gustavo Vulcano, Jiawei Zhang

We consider the problem of a technology firm deciding the optimal timing of its product launches. Consumers are strategic and weigh the value of purchasing improved products in light of future technological improvements. We completely characterize the optimal launch policies for two cases: one where the firm pre-announces the product launch times in the market, and the second where no information about the future launches is divulged. Revenue gap between both cases can be very significant.

2 - Information Release under New Product Introduction

Pnina Feldman, University of California-Berkeley, 545 Student Services Bldg, #1900, Berkeley, CA, 94720, United States of America, feldman@haas.berkeley.edu, Bo Liao, Robert Swinney

We characterize a technology firm's optimal information release strategy prior to introducing a new product version. Facing a tradeoff between depleting old-version inventory and inducing customers to wait for the latest version, the firm influences customers' purchasing behavior by moderating information about the new product it discloses to the customers. We investigate conditions under which it is optimal to announce information about product release timing, availability, quality, and price.

3 - Markdown Management: Pricing as a Signaling Device

Gad Allon, Professor, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Achal Bassamboo, Ramandeep Randhawa

We study the classical revenue management scenario of a monopolist retailer selling to customers over a finite horizon. The retailer possesses information about the aggregate demand, whereas customers have private information on their valuations and are strategic. We study how the profit maximizing retailer strategically uses price as a signaling device.

4 - The Value of Centralized Product Design under Strategic Consumer Behavior

Robert Swinney, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, robert.swinney@duke.edu, Sang Kim

We show that decentralizing the supply chain into a design firm and a selling firm can lead to quality levels that are too low, causing more consumers to strategically delay their purchases for future discounts. Consequently, coordinating product design and operational decisions helps a supply chain mitigate strategic consumer behavior, helping explain the value of vertical integration in industries with a significant degree of strategic customer behavior, such as apparel.

■ TB45

Level 1 -101E

Design of Healthcare Appointment Systems

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Nan Liu, Assistant Professor, Columbia University, New York, NY, 10032, United States of America, nl2320@columbia.edu

1 - Appointment System Design for Fairness-based Operational Performance Targets

William Millhiser, City University of New York/ Baruch College, One Bernard Baruch Way, Box B9-240, New York, NY, 10010, United States of America, william.millhiser@baruch.cuny.edu, Emre Veral

We define generalizable principles in schedule design to meet operational targets of managed and fair waiting times and controlled provider overtime. Our simulation method iteratively sets each patient's appointed time using the prior patient's finish time distribution. The resulting templates follow generalizable patterns, moderated by allowances that account for service times, variability, show rates, and managerially established performance targets of patient delays and providers' overtime.

2 - Optimal Choice for Appointment Scheduling Window under Patient No-show Behavior

Nan Liu, Assistant Professor, Columbia University, New York, NY, 10032, United States of America, nl2320@columbia.edu

Observing that patients with longer appointment delays tend to have higher no-show rates, many providers put a limit on how far into the future that an appointment can be scheduled. We study how such choices of appointment windows affect a provider's operational efficiency. We consider two models. The first one assumes patients are homogeneous. The second model faces two types of patients differing in no-show and arrival rates, and the provider can use patient type-specific appointment windows.

3 - Joint Panel Sizing and Appointment Scheduling in Outpatient Care

Christos Zacharias, New York University, Stern School of Business, 44 West 4th Street, New York, NY, 10012, United States of America, czachari@stern.nyu.edu, Mor Armony

We study the joint problem of determining the panel size of a medical practice and the number of offered appointments per day, so that patients do not face long backlogs and the clinic is not overcrowded. By capturing many features of the healthcare system (balking, no-shows, random services), we model explicitly the two time scales involved in accessing care: out-of-clinic and in-clinic waits. Our analysis suggests that an "Open Access" policy is optimal in outpatient scheduling.

■ TB46

Level 1 -101F

Supply Chain Risk Management

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Xiaole Wu, Fudan University, Siyuan Building, 670 Guoshun Road, Shanghai, China, wuxiaole@fudan.edu.cn

1 - Supply Chain Coordination with Financial Constraints and Bankruptcy Costs

Wenhui Zhao, Associate Professor, Shanghai Jiao Tong University, Room 103, Building 4, 535 Fahuazhen Road, Shanghai, 200052, China, zhaownh108@gmail.com, Panos Kouvelis

We study a supply chain with a retailer having a single opportunity to order from a supplier to satisfy uncertain demand. Both parties may be capital constrained and incur bankruptcy risks if borrow short-term loans. We show that a revenue sharing contract with slight modification may still coordinate the chain, a buyback contract is equivalent to a revenue sharing contract for small bankruptcy costs but less efficient for high costs, and an all-unit quantity discount contract cannot coordinate.

2 - Contracting for Supply in an Unpredictable World

Fang Liu, Assistant Professor, Nanyang Technological University, Nanyang Business School, Singapore, Singapore, Liu_Fang@ntu.edu.sg, Tracy Lewis, Jing-Sheng Song

A group of retailers contract with a manufacturer for the eventual delivery of materials over T future time periods. They each undertake private investments to provide for and utilize the manufacturing capacity. We identify dynamic agreements that induce uncooperative members to make efficient private investments and capacity allocation decisions under unpredictable and unverifiable market conditions. We demonstrate the supply agreement through IFRC's warehouse capacity allocation problem.

3 - The Roles of Bank and Trade Credits: Theoretical Analysis and Empirical Evidence

Xiangfeng Chen, Associate Professor, Fudan University, School of Management, Shanghai, China, chenxf@fudan.edu.cn, Zhiguo Xiao, Gangshu Cai

This paper investigates the roles of bank and trade credits in a supply chain with a capital constrained retailer facing demand uncertainty. We evaluate the retailer's optimal order quantity and the creditors' optimal credit limits and interest rates in two scenarios. We further analytically prove that the relationship between bank and trade credits, and then empirically validate this prediction based on a panel of 674 firms in China over the period 2001—2007.

4 - The Value of Operational Flexibility in Uncertain Supply and Demand Environments

Xiaole Wu, Fudan University, Siyuan Building,670 Guoshun Road, Shanghai, China, wuxiaole@fudan.edu.cn, Lingxiu Dong, Panos Kouvelis

Refining is indispensable to almost every natural resource and agricultural commodity based industry. We investigate the interconnection among input procurement, intermediate processing, and output blending decisions in the refining process. We offer insights on how the market conditions affect the value of conversion flexibility and its interaction with range flexibility.

■ TB47

Level 1 -101G

Empirical Study of Efficiency and Productivity in Services: A Cross-Industry Perspective

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Sarang Deo, Indian School of Business, ISB Campus, Gachibowli, Hyderabad, 500032, India, Sarang_Deo@isb.edu

1 - A Longitudinal Analysis of Operating Profitability in the U.S. Airline Industry, 1988-2011

Michael Lapré, Vanderbilt University, Owen Graduate School of Management, 401 21st Ave. South, Nashville, TN, 37203, United States of America, Michael.Lapre@owen.vanderbilt.edu, Yasin Alan, Gary Scudder

In a longitudinal analysis of profitability (operating profit over operating revenue) in the U.S. airline industry, we examine drivers such as yield, loadfactor, fleet utilization, labor cost, fuel cost, flight length, plane size, and on-time performance. We contrast legacy carriers with focused carriers. We also contrast operating models before and after 9/11.

2 - Learning in IT Enabled Services

Bradley Staats, Univrsity of North Carolina, Chapel Hill, NC, United States of America, Bradley_Staats@kenan-flagler.unc.edu, Francesca Gino

In this work we examine factors that drive variation in productivity in IT enabled services.

3 - Having your Cake: An Empirical Study of the Impact of Workload on Worker Productivity

Tom Tan, Cox Business School, Southern Methodist University, 6212 Bishop Blvd, Dallas, TX, 75275, United States of America, ttan@cox.smu.edu, Serguei Netessine

We find inverted-U shaped relationships between workload and performance. In the focal restaurant chain we find that this saturation point is generally not reached and, counter-intuitively, the chain can reduce the staffing level and achieve both significantly higher sales (an estimated 3% increase) and lower labor costs (an estimated 17% decrease).

4 - Clinical and Operational Drivers of Efficiency in an OPD: Non-stationarity, Variety, and Deadlines

Sarang Deo, Indian School of Business, ISB Campus, Gachibowli, Hyderabad, 500032, India, Sarang_Deo@isb.edu, Aditya Jain, Pradeep Pendem

Using data from ~70,000 patient visits to a specialty eye care OPD in India, we estimate a dynamic panel model to understand how clinical and operational factors affect the average length of stay (LOS). We construct appropriate measures based on clinical codes to distinguish between clinical complexity and variety and find that both have a negative effect on LOS. We also find that average LOS increases with completed workload (fatigue) but decreases towards the end of the day (deadline effect).

■ TB48

Level 1 -101H

B2B Pricing

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Wedad Elmaghraby, Associate Professor, University of Maryland, RH Smith School of Business, Van Munching Hall Room 4352, College Park, MD, 20742-1815, United States of America, wedad_elmaghraby@rhsmith.umd.edu

Co-Chair: Anna Devlin, University of Maryland, College Park, MD, United States of America, adevlin@rhsmith.umd.edu

1 - Evidence of Reference Prices in B2B Markets for Used Products

Wedad Elmaghraby, Associate Professor, University of Maryland, RH Smith School of Business, Van Munching Hall Room 4352, College Park, MD, 20742-1815, United States of America, wedad_elmaghraby@rhsmith.umd.edu, Ali Pilehvar, Anand Gopal

We empirically study the performance of online auctions for returned products. We find evidence of differential impact of reference prices, emerging from concurrent auctions, on bids submitted in an auction, based on a bidder's experience.

2 - Dynamic Targeted Pricing in B2B Settings

Jonathan Zhang, Assistant Professor of Marketing, University of Washington, 547 Paccar Hall, Box 353226, Seattle, WA, 98195, United States of America, zaozao@uw.edu, Oded Nezter, Asim Ansari

We model the multifaceted impact of pricing decisions in B2B and show how a seller can develop optimal inter-temporal targeted pricing strategies, taking into account the latent B2B relationships. We model the B2B customer's purchase decisions in an integrated hierarchical Bayesian framework, with a multivariate non-homogeneous hidden Markov model. We estimate our model on data from an industrial retailer, and find two latent relationship states - a "vigilant" state and a more "relaxed" state.

3 - Bargaining with A Residual Claimant: An Experimental Study

Kyle Hyndman, University of Texas at Dallas, 800 West Campbell Road, Richardson, TX, 75080, United States of America, kyle.hyndman@gmail.com, Matthew Embrey, Arno Riedl

Often when two parties bargain, one side is exposed to risk while the other is not. Theory provides conditions for which the residual claimant is better off when facing risk. We conduct an experiment to test this prediction and also whether residual claimants choose riskier distributions over which to bargain. We show that residual claimants are often better off being exposed to risk but, in a follow-up, also show that they are reluctant to choose riskier distributions.

4 - Making the Market Material: Managing Price Exceptions in B2B Markets

Mark Bergen, Professor, James D. Watkins Chair in Marketing, Associate Dean of Carlson Executive Education Programs, University of Minnesota, Carlson School of Managment, 321 19th Avenue South, minneapolis, 55455, United States of America, mbergen@umn.edu, Mark Zbaracki

We focus on three successive pricing directors and their battles over "exceptions" to their list prices at a large, Midwestern manufacturing firm. We find that each manager created a set of artifacts to improve pricing that were material steps in the directions they were hoping to accomplish, and that subsequent managers used parts of these artifacts in combination with new artifacts to implement their vision of pricing.

■ TB49

Level 1 -101I

Market Microstructure and High-Frequency Trading

Cluster: Tutorials

Invited Session

Chair: Ciamac Moallemi, Associate Professor, Columbia University, 3022 Broadway Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

1 - High-Frequency Trading and Modern Market Microstructure

Ciamac Moallemi, Associate Professor, Columbia University, 3022 Broadway Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

Driven by technological advances, modern financial markets have become an electronic world dominated by automated agents that interact algorithmically. Markets are now characterized by decision-making that evolves on a microsecond timescale, with activity fragmented across many exchanges and alternative market structures. This has led to challenging new decision problems for market participants. This tutorial explores some of the basic questions and resulting models.

■ TB50

Level 1 -101J

Energy IV: Renewable Energy and Environment

Contributed Session

Chair: K. Jo Min, Dr., Iowa State University, Dept. of IMSE, 3004 Black Engineering, Ames, IA, 50011, United States of America, jomin@iastate.edu

1 - Decentralized Prosumer-based Unit Commitment

Mohammadjavad Feizollahi, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, feizollahi@gatech.edu, Shabbir Ahmed, Santiago Grijalva, Mitch Costley

Unit commitment (UC) is historically a massive, centralized problem of determining electric utility power generation schedules. In response to many industry trends, we propose a model to solve UC in a power system with a decentralized, prosumer-based architecture. This formulation decomposes a large MIP into smaller problems that collaborate to reduce disagreement in joint constraints and obtain near-optimal solutions. We also develop and test algorithms to mitigate the problem's nonconvexity.

2 - Generation and Transmission Maintenance Scheduling Considering Renewable Energy

Yi Fang, West Virginia University, Evansdale Dr, Morgantown, United States of America, yfang@mix.wvu.edu, Qipeng Phil Zheng

This research presents a novel stochastic model for the mid-term maintenance scheduling of generators and transmission lines with short-term operations planning. The model takes renewable energy into consideration and uses three types of risk constraints to control the system losses. The model is a mixed-integer programming problem and two optimization techniques are proposed. Numerical results are also displayed.

3 - Government Incentive Policy for Renewable Power Producers

K. Jo Min, Dr., Iowa State University, Dept. of IMSE, 3004 Black Engineering, Ames, IA, 50011, United States of America, jomin@iastate.edu, Chung-Hsiao Wang

In this paper, we first construct an economically rational model of a representative power producer who optimally reacts to a government incentive policy given the uncertainty of the power price. We then show how the government's equilibrium timing can be determined in terms of the optimal power price threshold as well as the optimal level of the incentive to maximize the social welfare. With respect to key parameters such as the level of volatility, a sensitivity analysis will be performed.

4 - Inter-state Electricity Trading with Carbon Capture and Storage: Good Investment Decision?

Karim Farhat, PhD Student, Energy Policy and Strategy, Management Science and Engineering, Stanford University, 367 Panama Street, Stanford, CA, 94305, United States of America, kfarhat@stanford.edu

This paper investigates a utility's decision to invest in exporting coal-generated electricity from Wyoming to California while meeting strict environmental regulations. The company considers implementing Carbon Capture and Storage, Enhanced Oil Recovery, and CO2 Interim Storage, while facing major uncertainties: investment tax credits, oil and CO2 prices, and variable electricity prices. Decision Analysis is used to perform a detailed financial assessment in view of current regulations.

■ TB51

Level 1 -102D

Transit Modeling

Sponsor: Transportation Science & Logistics/Urban Transportation

Sponsored Session

Chair: Miguel Figliozzi, Associated Professor, Portland State University, PSU - CEE, PO Box 751, Portland, OR, 97207-0751, United States of America, figliozzi@pdx.edu

1 - An Optimization Approach for Cyclic and Non-cyclic Crew Rostering Problems in Public Transit

Leena Suhl, Professor, University of Paderborn, Warburger Str. 100, Paderborn, 33098, Germany, suhl@upb.de, Lin Xie

The crew rostering problem in public transport addresses the tasks of assigning drivers to a given set of duties with consideration of various rules. Optimal rosters are characterized by maximum satisfaction of drivers and minimal operational costs. We formulate the problem as a multi-commodity network flow problem which is very flexible and can accommodate a variety of constraints. With a minor modication, one network can formulate the cyclic and non-cyclic crew rostering problems.

2 - Incorporating Equity Concerns into Vehicle Routing Problem for Bus Route Design

Kelly Bertolaccini, University of Connecticut, 261 Glenbrook Rd., unit 3037, Storrs, Ct, 06269, United States of America, kelly.bertolaccini@engr.uconn.edu, Nicholas Lownes

This research develops a method for considering equity in vehicle routing for bus networks. Several objective functions reflecting different definitions of equity are used to formulate the VRP. The VRP formulations are applied to several networks and solved using a genetic algorithm. The results of using the equity objective functions are compared to the results of a cost minimizing function on different sized networks to examine the cost of designing for different definitions of equity.

3 - Analyzing the Impacts of Traffic Conditions, Adaptive Traffic Signal Control, Transit Signal Priority

Miguel Figliozzi, Associated Professor, Portland State University, PSU - CEE, PO Box 751, Portland, OR, 97207-0751, United States of America, figliozzi@pdx.edu, Wei Feng

We integrate several sources of data including bus automatic vehicle location (AVL), automatic passenger count (APC), SCATS signal timing data and traffic movement data at each intersection along a corridor. We present the results of regression models that quantify the joint impacts of traffic conditions, adaptive traffic signal control, transit signal priority and bus stop location (near-side or far-side bus stops) on bus travel times.

■ TB52

Level 1 -102E

Transport, Trade and Logistics

Sponsor: Transportation Science & Logistics/Freight T ransportation & Logistics

Sponsored Session

Chair: John Liu, Professor, City University of Hong Kong, Ctr of Transport, Trade and Finance, Tat Chee Ave., Kowloon, Hong Kong - PRC, johnliu@cityu.edu.hk

1 - Transaction Cost Analysis of Supply Chain Logistics: Firm Based versus Port Centric

Dong-qing Yao, Professor, Towson University, 8000 York Road, Towson, MD, 21252, United States of America, dyao@towson.edu, John Liu, Ziping Wang

We develop a transaction cost frontier model. Key findings are: 1) Logistics efficiency is critically dependent on both intra-firm asset specificity and inter-firm environment heterogeneity with port as transaction facility. 2) There is a logistics transaction cost economics that an adaptive advantage can be gained through port-centric industrialization of supply chains, which leads to geographically concentrated horizontal specialization and differentiation.

2 - Determining the Optimal Number of Suppliers in Global Supply Chain Networks under Supply Disruption

Seong-Hyun Nam, Professor, University of North Dakota, 293 Centennial Drive Stop 8377, Grand Forks, ND, 58202-8377, United States of America, snam@business.und.edu

The research paper focus on the trends in competitive business environments in that companies are reducing their number of suppliers and the impacts that it makes. Through this study we attempt to develop an analytical model for determining the optimal number of suppliers to minimize the total cost considering the risks of catastrophic events.

3 - Co-movement between Shipping Industry and Global Markets

Gilbert Y. F. Wang, Senior Scientific Officer, City University of Hong Kong, Ctr of Transport, Trade and Finance, Tat Chee Ave., Hong Kong, Hong Kong - PRC, gilbertw@cityu.edu.hk, John Liu, Hui Bu, Laser J. G. Yuan

Noting shipping as the artery of international trade, this paper investigates the co-movement between shipping industry and global markets. We use Multivariate DCC GARCH model to conduct this analysis. We estimate and forecast the dynamic conditional variances and correlations among the demand of shipbuilding, the Baltic Dry Index and some other economic indexes. We find that the dependencies/correlations vary over time, with significant structure changes during the crises periods.

■ TB53

Level 1 -102F

Advances in Vehicle Problems I

Contributed Session

Chair: Zelda Zabinsky, Professor, University of Washington, Industrial and Systems Engineering, Seattle, WA, 98195-2650, United States of America, zelda@u.washington.edu

1 - Generalized Vehicle Routing Game Algorithm

Hyunchul Tae, Doctoral Candidate, POSTECH, Hyoja, Pohang, Korea, Republic of, scipio@postech.ac.kr, Byung-In Kim

A vehicle routing problem (VRP) is to find a fleet of routes of vehicles with the minimum total cost satisfying various constraints. A vehicle routing game (VRG) is the problem of finding a fair allocation of the VRP's total cost to customers. Previous VRG algorithms could solve the instances with limited size of customers and a single constraint. Our proposed algorithm can solve larger problems with multiple constraints.

2 - An Optimization Algorithm for Multi-trip Multi-shift Vehicle Routing Problems

Zelda Zabinsky, Professor, University of Washington, Industrial and Systems Engineering, Seattle, WA, 98195-2650, United States of America, zelda@u.washington.edu, Joseph Heim, Cao Xiao, Shabnam Zangeneh-Khamooshi

This research is motivated by the UW Medical Center needing to transport medical specimens from clinics, physicians' offices, and hospitals to a central laboratory. This is a version of a Vehicle Routing Problem with Time Windows, where goods must be picked up within time frames and delivered quickly to a central depot. We present an algorithm, named VeRSA, that employs scheduling theorems embedded into branch and bound. Numerical results show that VeRSA obtains a feasible solution quickly.

3 - Vehicle Routing Problem with Multiple Cross-docks

Mohammad Yousef Maknoon, Ecole Polytechnique Montreal, 50 Willowdale, Apt. 108, Outremont, QC, h3t1g1, Canada, mohammad-yousef.maknoon@polymtl.ca, Gilbert Laporte

Vehicle routing problem with cross-docking, a homogeneous set of vehicles carry freights from origins to destinations. Each request has a transferring demand and it could either be picked up or delivered by multiple vehicles via cross-docks. The objective is to propose efficient routes via which all requests are served while reducing total cost. The cost is evaluated based on traveling distance. An adoptive large neighborhood search is presented as a resolution approach.

4 - Modeling and Solving for the Multi-trip Vehicle Routing Problem with Multiple Time Windows

Qiyuan Sun, Xi'an Jiao Tong University, West Xian Ning Rd. 28#, Xi'an, Xi'an, China, sunqiyuan.1986@stu.xjtu.edu.cn, Zhili Zhou

This paper studied this kind multi-trip vehicle routing problem with multiple time windows (MVRPMTW). A linear programming formulation and a two-stage heuristic were developed, which first used a modified insert algorithm to construct the initial solution, then improved it with an adaptive large neighborhood search heuristic.

■ TB54

Level 1 -103A

Dynamic Traffic Assignment III -Data Issues

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Tao Yao, Associate Professor, Pennsylvania State University, 349 Leonhard Building, University Park, PA, 16802, United States of America, tyy1@engr.psu.edu

1 - Second Order Models and Traffic Data from Mobile Sensors

Hongcheng Liu, PhD Candidate, Pennsylvania State University, 240 Leonhard, University Park, PA, United States of America, hql5143@psu.edu, Benedetto Piccoli, Terry Friesz, Tao Yao, Ke Han

A data-enabled computational method is proposed for highway traffic when the second-order Phase Transition Model is employed. Such model, in contrast to first-order models, captures higher-order variations inherent in traffic stream. We use the NGSIM dataset to illustrate the unique insight of how the estimation of first- and second-order traffic quantities deteriorates as the sampling frequency and probe penetration rate change.

2 - Instantaneous Dynamic User Equilibrium: A Case Study

Rui Ma, Research Assistant, Rensselaer Polytechnic Institute, 110 8th Street, JEC 5107, Troy, NY, 12180, United States of America, mar2@rpi.edu, Xuegang Ban

We show how the instantaneous dynamic user equilibrium model can be applied to solve a real traffic network problem. Model results are compared with real world observations with some interesting findings.

3 - Measuring Inefficiency in Dynamic Traffic Networks: A Numerical Study

Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, Kien Doan

In this study, we first categorize different circumstances of the network inefficiency and the price of anarchy. Instead of finding a tight bound for the price of anarchy, we explore the trend of the network inefficiency in more realistic networks. We begin with the departure time choice single bottleneck model. Then the general dynamic networks are considered for different demand levels. Open questions of interest to the research community will be discussed.

4 - Determining the Traffic State under Tradable Energy Quotas (TEQs): Dynamic User Equilibrium Model with Path Based Cell Transmission Model

H. M. Abdul Aziz, Ph.D. Candidate, Purdue University, 150 Arnold Dr. Apt. 15, West Lafayette, IN, 47906, United States of America, haziz@purdue.edu, Satish Ukkusuri

This research analyzes the change in route choice behavior and accordingly the transportation planning process after the implementation of Tradable Energy Quotas (TEQs). TEQs is a widely studied personal carbon trading (PCT) scheme aiming at cutting down GHG emission and fossil fuel consumption. We develop mathematical models to determine traffic state under dynamic user equilibrium behavior where each user minimizes carbon credit consumption (to maintain the energy quota) in addition to travel time.

5 - Transportation Network Design Problem under the Boundedly Rational Route Choice Behavioral Assumption

Henry X. Liu, Associate Professor, University of Minnesota, Minneapolis, MN, 55455, United States of America, henryliu@umn.edu, Xuan Di

Many empirical studies have shown that drivers are boundedly rational in reality. Because the boundedly rational user equilibria (BRUE) are non-unique and the set containing all equilibria is not convex, the network design problem is quite challenging and has not yet been studied. By analyzing the structure of the BRUE set, we propose a methodology of the transportation network design within the boundedly rational route choice framework.

■ TB55

Level 1 -103B

Traffic Modeling and State Estimation using Emerging Data Sources

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Xuesong Zhou, University of Utah, MCE Building 2135, 110 S. Central Campus Dr., Salt Lake City, UT, 84112, United States of America, xzhou99@gmail.com

1 - Particle Filter Based Real-time Freeway Traffic State Estimation with Lagrangian Measurements

Kerem Demirtas, Research Assistant, Arizona State University, Tempe, AZ, 85281, United States of America, kerem.demirtas@asu.edu, Zhuoyang Zhou, Pitu Mirchandani

With the development of modern traffic flow sensing technologies, various vehicle-based Lagrangian measurements become available for enhancing traffic state estimation. This research designs a particle filter in the Lagrangian coordinate system for estimating the evolution of traffic state over time and space. Validation against other existing estimators shows improved accuracy.

2 - Estimating Link-based Traffic Flow Dynamics from Bluetooth and GPS Sensor Data: A Linear Programming Reformulation

Xuesong Zhou, University of Utah, MCE Building 2135, 110 S. Central Campus Dr., Salt Lake City, UT, 84112, United States of America, xzhou99@gmail.com, Jiangtao Liu

This talk presents a new linear programming formulation to utilize multiple data sources, including link count, travel time, OD split fractions from Bluetooth and GPS data, to estimate dynamic traffic OD matrices. A real-world test case is used to evaluate the performance of the proposed model.

3 - Estimating Short-Term Path Travel Time Reliability using Decentralized Vehicle-to-Vehicle Information System

Shubham Agrawal, Purdue University, NEXTRANS Center, 3000 Kent Avenue, West Lafayette, IN, 47907, United States of America, shubham@purdue.edu, Srinivas Peeta, Xiaozheng He

This study proposes a statistical model to estimate short-term path travel time reliability using vehicle-to-vehicle (V2V) communication data. Most existing studies rely on assumptions on link travel time distribution to infer path travel time reliability using data from point sources such as detectors. The proposed model employs observed low-latency data from V2V to circumvent this limitation.

4 - Platoon Based Arterial Route Travel Time Estimation using Mobile Sensor Data

Peng Hao, RPI, 12 25th St., Troy, NY, 12180, United States of America, haop@rpi.edu, Xuegang Ban

The authors aim to estimate the arterial corridor travel times using sample travel time data from mobile sensors. For the link segment, the platoon dispersion model is applied to compute the link travel time and arrival rate at downstream intersection. For the intersection area, the derived time-dependent arrival pattern is utilized to construct the dynamic delay pattern. This model is calibrated and tested using NGSIM data set.

■ TB56

Level 1 -103C

Operations and Planning with Energy Storage

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Ramteen Sioshansi, Assistant Professor, The Ohio State University, Integrated Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, sioshansi.1@osu.edu

1 - Estimating Capacity Value of Energy Storage using Dynamic Programming

Seyed Hossein Madaeni, Pacific Gas and Electric Company, 77 Beale St. Room 2567A, San Francisco, CA, 94105, United States of America, SHM8@pge.com, Ramteen Sioshansi, Paul Denholm

We use dynamic programming to model the effect of power outages on operations and state of charge of storage in subsequent periods. We then estimate the state of charge probability distribution and use it as a forced outage rate of the storage device in standard reliability-based capacity value estimation techniques. We demonstrate the advantages of the proposed methodology over existing approximation techniques using numerical case studies.

2 - Optimization of Concentrating Solar Power with Thermal Energy Storage in a Production Cost Model

Marissa Hummon, National Renewable Energy Laboratory, 15013 Denver West Parkway, Golden, CO, 80401, United States of America, Marissa.Hummon@nrel.gov, Paul Denholm, Jennie Jorgenson, Mark Mehos

Concentrating solar power with thermal energy storage (CSP-TES) can provide multiple benefits to the grid, but must be modeled to allow for the optimization of each component of the plant. We present a high fidelity model of CSP-TES, show the value of CSP-TES in a high renewable penetration scenario, and the effect of modeling simplifications including scheduled versus optimized dispatch and 24-hour ahead dispatch versus real time sub-hour dispatch, on the value of CSP-TES.

3 - A Stochastic Dynamic Programming Model for Co-optimization of Distributed Storage

Xiaomin Xi, The Ohio State University, 210 Baker System Building, 1971 Neil Ave., Columbus, OH, 43220, United States of America, xi.12@osu.edu, Ramteen Sioshansi, Vincenzo Marano

We develop a stochastic dynamic programming model that co-optimizes the use of energy storage for multiple applications, such as energy, capacity, and backup services, while accounting for market and system uncertainty. Using the example of a used battery from a plug-in electric vehicle that has been remanufactured and installed in a home as a distributed storage device, we demonstrate the ability of the model, and show that secondary uses of PEV batteries can provide substantive value.

4 - Energy Storage Systems, Stochastic Optimization and Robust Control

Alberto Lamadrid, Assistant Professor, Lehigh University, 621 Taylor Street, room 451, Bethlehem, PA, 18015, United States of America, ajlamadrid@lehigh.edu, Tim Mount, Ray Zimmerman, Carlos Murillo-Sanchez

This paper formulates an energy storage problem, in the context of high penetration of renewable energy sources (RES), as used by System Operators in their daily operations. Our suggested model has an electricity network system planner seeking to maximize the welfare of consumers and producers, procuring energy and ancillary services using a security constrained Optimal Power Flow (SC-OPF) and reproducing the uncertainty in the system by using a Markovian transition probability matrix.

■ TB57

Level 1 -103D

Transmission Topology Control and Optimization

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Kory Hedman, Professor, Arizona State University, PO Box 875706, GWC 206 School of ECEE ASU, Tempe, AZ, 85287-5706, United States of America, Kory.Hedman@asu.edu

1 - Transmission Switching for Large Scale Electrical Networks

Zhu Yang, PhD Student, University of California, Berkeley, 970 Adams St., Apt. A, Albany, CA, 94706, United States of America, yangzhu165@gmail.com, Shmuel Oren

Transmission switching is the problem of optimizing the topology of an electric power network in order to minimize the dispatch cost. The optimal transmission switching problem which formulates the transmission switching as a mixed-integer program, usually takes a long time to solve in practice. We present algorithms in parallel to achieve satisfactory cost reduction as well as reasonable computation time. We apply the algorithms to FERC 13867 bus test case.

2 - Robust Topology Control for System Reliability

Akshay Korad, PhD Student, Arizona State University, Tempe, AZ, 85281, United States of America, akshay.korad@asu.edu, Kory Hedman

Corrective transmission switching schemes are an essential part of grid operations and are used to improve the reliability of the grid as well as the operational efficiency. Today, the transmission switching schemes are established based on the operator's past knowledge of the system as well as other ad-hoc methods. The proposed robust corrective topology control tool provides a systematic approach to determine topology control actions that are robust against load and wind uncertainty.

3 - Line Cancelling Transaction Based Topology Control Extensions and Large System Applications

Michael Caramanis, Boston University, 15 St. Mary's St., Room 137, Brookline, MA, 02446, United States of America, mcaraman@bu.edu, Evgeniy Goldis

Line Cancelling Transactions (LCTs) can model the impact of transmission line switching on injection sensitivity factors [Guller, Gross and Liu, 2007]. Moreover, LCTs have been incorporated in a MILP topology control optimization algorithm (TCA) demonstrating orders of magnitude higher efficiency over previously used B Theta algorithms (Ruiz et al. 2012). We will present extensions to LCT-based TCA algorithms that model Losses, and report on large (multiple thousand buses) System applications.

4 - Topology Control for Load Shed Recovery

Adolfo Escobedo, Graduate Research Assistant, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, adolfoescobedo@tamu.edu, Kory Hedman, Erick Moreno-Centeno

We introduce the dc optimal load shed recovery with transmission switching model (DCOLSR-TS), which seeks to reduce potential post-contingency load shedding by modifying the system topology. Since solving DCOLSR-TS is computationally difficult, we develop a heuristic (MIP-H), which improves the system topology while specifying the sequence of switching operations. We argue the use of a parallelized version of MIP-H for on-line load shed recovery and recurring contingency-response analysis.

■ TB58

Level 1 -103E

Risk Management in Electricity Markets

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Eddie Anderson, University of Sydney, University of Sydney Business School, Sydney, Australia, edward.anderson@sydney.edu.au

1 - Risk Trading in Multi-stage Stochastic Equilibrium

Andy Philpott, University of Auckland, Private Bag 92019, Auckland, New Zealand, a.philpott@auckland.ac.nz

We study multi-stage stochastic equilibrium models of risk trading in electricity markets with hydroelectric reservoir storage. Under an assumption of perfectly competitive and complete risk markets, we show how risk preferences expressed by dynamic coherent risk measures can be integrated into a risk averse social planning problem. We also discuss incomplete markets and present examples that demonstrate the welfare enhancing effects of risk-trading instruments of various types.

2 - Energy and Reserve Dispatch in Electricity Markets: A Robust Optimization Approach

Antonio Conejo, University of Castilla-La Mancha, Department of Electrical Engineering, Campus Universitario, Ciudad Real, 13071, Spain, Antonio.Conejo@uclm.es, Marco Zugno

We consider the dispatch of electric energy and reserve in a system with stochastic production units, and propose an adaptive robust optimization model. Using duality, we merge the uncertainty and recourse inner problems into a single problem with equilibrium constraints, which is cast as a MIP. We solve the outer dispatching problem with a cutting-plane method using either dual or primal cuts. Results obtained are compared with those derived from the corresponding stochastic programming model.

3 - Financial Markets Can Prevent Inefficient Entry in a Competitive Industry

Bert Willems, Tilburg University, PO Box 90153, Room K324, Tilburg, Netherlands, willems.bert@gmail.com, Joris Morbee

Investments can be socially inefficient in perfectly competitive markets with homogenous goods, if firms are risk averse and financial markets are incomplete. Entrants underinvest in technologies that reduce aggregate sector risk. Inefficiencies disappear when the financial market is complete, although the introduction of individual tradable instruments may decrease efficiency. When an entrant invests only in the financial market and not in productive assets, there are no inefficiencies.

4 - Competing for Reservation Payments

Eddie Anderson, University of Sydney, University of Sydney Business School, Sydney, Australia, edward.anderson@sydney.edu.au

We consider generators competing to supply an uncertain demand, where "reservation payments" are made to ensure sufficient supply. In our model there are both reservation and execution prices. The buyer decides which blocks of capacity to reserve and pays the reservation price. After demand occurs the reserved capacity is dispatched in order of the execution price. We explore the structure of this model, and describe the optimal buyer policy and the equilibrium between generators.

■ TB59

Level 1 -103F

Sustainable Natural Resource Management with Environmental Concerns

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Nicholas Petruzzi, Associate Professor of Business Administration, University of Illinois, 350 Wohlers Hall, 1206 S. 6th St., Champaign, IL, 61822, United States of America, petruzzi@illinois.edu

1 - Long-Term Water Allocation Models under Uncertainty

Guzin Bayraksan, The Ohio State University, Integrated Systems Engineering, Columbus, OH, United States of America, bayraksan.1@osu.edu

We present long-term, multi-period generalized network water allocation models under water demand and supply uncertainty. We discuss different ways to incorporate uncertainty in the model, resulting in different classes of stochastic programs. We also discuss how these uncertainties can be tied to regional climate models. We apply our models to allocate Colorado River water to a southeast region of Tucson, Arizona and present computational results.

2 - Implementation of Energy Efficiency Initiatives: An Empirical Investigation

Jason Nguyen, University of Minnesota, Twin Cities, 321 19th Avenue South, Minneapolis, MN, 55455, United States of America, nguy1762@umn.edu, Karen Donohue, Rachna Shah

We develop a framework to predict energy efficiency implementation by firm and industry specific determinants, and test it using combined secondary data of 357 public traded firms. We ?nd that sub industry, integration of climate change into business strategy, and firm's perceived opportunity are positively correlated with the probability to implement energy efficiency solutions, while firm's size, environmental risk attitude and external communication do not seem to have any significant impact.

3 - Evaluation and Optimization of a One-Warehouse, N-Retailer Distribution System with Reverse Flows

Gregory DeCroix, Professor, University of Wisconsin–Madison, Wisconsin School of Business, 975 University Avenue, Madison, WI, 53562, United States of America, gdecroix@bus.wisc.edu

We study a distribution system facing stochastic demands and returns. We propose heuristic inventory policies—based on local or centralized control and different cost approximations—and find these are nearly optimal within the classes considered. Centralized control performs better on average, but the advantage is small when the number of retailers is small or large. Also, it is better to receive returns at the retailers (warehouse) when the number of retailers is relatively small (large).

4 - Water Management: Optimal Planning and Allocation of Renewable Natural Resource

Karthik Murali, PhD Candidate, University of Illinois at Urbana-Champaign, 350 Wohlers Hall, Urbana, IL, 61820, United States of America, kmurali4@illinois.edu, Nicholas Petruzzi, Michael Lim

We study the optimal supply management problem for the manager of a renewable aquifer. The manager must determine the optimal level of water transfers between municipalities and investment in water production technology. Using a stylized model, we determine the optimal policy for a profit or welfare-maximizing manager, and compare their impacts using the Triple Bottom Line framework. We obtain managerial insights and draw implications for policy related to sustainable water management.

■ TB60

Mezzanine - 100A

Mathematical Optimization in Data Mining

Sponsor: Data Mining

Sponsored Session

Chair: Romero Morales, Professor, University of Oxford, Said Business School, Oxford, United Kingdom, dolores.romero-morales@sbs.ox.ac.uk

1 - A Probabilistic L1–Method For High Dimensional Clustering

Tsvetan Asamov, Rutgers University, 640 Bartholomew Rd., Piscataway, NJ, 08854, United States of America, tsvetan.asamov@gmail.com, Adi Ben-Israel

Distance–based methods for clustering or classification of high–dimensional data often suffer from the unreliability of distances in very high–dimensional spaces. We propose a probabilistic clustering method based on the L1–distance that is less sensitive to the high dimensionality. The complexity of the algorithm is linear in the dimension of the data space, and its performance was observed to improve significantly as that dimension increases.

2 - A Revised Formulation of Proximal Support Vector Machine with Feature Selection via L21-Norm

Jiaxing Pi, University of Florida, 401 Weil Hall, Gainesville, FL, 32611, United States of America, jiaxing@ufl.edu, Vijay Pappu, Paul Thottakkara, Panos Pardalos

Proximal Support Vector Machine has been an efficient technique to generate classifiers and feature selection is an important tool for high dimensional data. The purpose of this research is to combine PSVM with L21-Norm in the objective function, which produces classifiers and relevant features simultaneously. An optimization method is provided to solve the formulation efficiently. Experiments on standard data sets are performed to compare the proposed framework with the standard PSVM.

3 - Strongly Agree or Strongly Disagree? Rating Features in Support Vector Machines

Romero Morales, Professor, University of Oxford, Said Business School, Oxford, United Kingdom, dolores.romero-morales@sbs.ox.ac.uk, Emilio Carrizosa, Amaya Nogales Gomez

We propose the Integer Support Vector Machine (ISVM), where the feature scores can take only a discrete amount of values. The ISVM classifier can be seen as a collection of Likert scales each rating the level of agreement with the positive class. We propose a Mixed Integer Linear Programming formulation and three reduction strategies. Our computational results show that the 3-point and 5-point ISVM classifiers have comparable accuracy to that of SVM, with a gain in interpretability.

■ TB61

Mezzanine - 100B

Data-driven Simulation Modeling

Sponsor: Data Mining

Sponsored Session

Chair: Durai Sundaramoorthi, Washington University in St. Louis, Olin Business School, Saint Louis, MO, 63141, United States of America, dsundaramoorthi@gmail.com

1 - An Integrated-tool to Predict the Environmental Impact of Airport Deicing Operations

Brian Huff, Associate Professor, The University of Texas at Arlington, Box 19017, Arlington, TX, 76019-0017, United States of America, bhuff@uta.edu, Victoria C Chen, Hui-Chiao Jen

Strategies for integrating a number of statistical, analytical, and simulation-based modeling environments into an interactive decision support tool will be presented. This talk will present a case study that required the development of a prototype decision support tool capable of mitigating the impact of airport deicing activities on the dissolved oxygen levels in adjacent waterways.

2 - Data-driven Simulation for Workforce Scheduling and Cold Storage Design for Seedling Grafting

Chao Meng, University of Arizona, Rm 111, Old Engr Bldg, 1127 E. James E. Rogers Way, Tucson, AZ, 85721, United States of America, meng5656@gmail.com, Young-Jun Son

A data-driven approach integrating discrete event simulation and meta-heuristic is proposed to find the optimal number of grafting workers and the size of cold storage in grafted seedling propagation simultaneously. The objective is to minimize the average order loss rate under various demand patterns while keeping certain investment payout period. A large grafted seedling propagator (over 12 million plants grafted annually) in North America is used to demonstrate the proposed approach.

3 - A Data-driven Prescriptive Analytics Approach to Optimize a Portfolio

Durai Sundaramoorthi, Washington University in St. Louis, Olin Business School, Saint Louis, MO, 63141, United States of America, dsundaramoorthi@gmail.com, Jay Rosenberger, Aihong Wen, Victoria C Chen

Classification and Regression Trees (CART) is a method of predictive analytics that attempts to predict or classify using a set of continuous or categorical variables. In this research, using CART, a simulation model has been developed to observe transition states of stocks in a portfolio. Utilizing design of experiments, objective values are observed from the simulation at selected portfolio points. We then approximate the objective function to use in prescriptive analytics.

■ TB62

Mezzanine - 100C

Image and Functional Data Analysis: Methods and Applications II

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kamran Paynabar, Georgia Institute of Technology, Atlanta, GA, United States of America, kamran.paynabar@isye.gatech.edu

1 - Gaussian Process Modeling of Big Datasets

Sam Tajbakhsh, PhD Student, The Pennsylvania State University, 801 W. Aaron Dr., Apt. A5, State College, PA, 16803, United States of America, sdt144@psu.edu, Enrique Del Castillo

Gaussian Processes (GP) have been widely used to model spatial data which are continuous in nature. Recent advancements in remote sensing technologies make abundant data available for analysis. However, the large size of the observed data poses computational challenges in matrix operations using the GP prediction model. In this work, we use multi-resolution basis functions to project the spatial process onto a lower dimension subspace to ease the computational effort of the predictive process.

2 - An Integrated Framework to Model the Trajectories of Chronic Conditions

Adel Alaeddini, Assistant Professor, University of Texas at San Antonio, San Antonio, TX, United States of America, Adel.Alaeddini@utsa.edu

Nearly 75 million people in the United States have one or more chronic conditions, conditions that last a year or more and require ongoing medical attention and/or limit activities of daily living. While some patients display a stable trajectory over time, others display a trajectory of deterioration and/or improvement. The main objective of this research is to identify trajectories among patients with chronic conditions at baseline and describe patterns of trajectories.

3 - Image-Based Process Monitoring using Low-Rank Tensor Decomposition

Hao Yan, Georgia Institution of Technology, 755 Ferst Dr, Atlanta, GA, 30336, United States of America, yanhaopku@gmail.com, Kamran Paynabar, Jianjun Shi

Among various sensing techniques, image sensors have attracted special attention in process monitoring due to rich process information provided by these sensors. The main objective of this research is to use low-rank tensor decomposition techniques and develop image-based monitoring methods that effectively utilize the spatial and color information of image data. Using simulation and a case study, the performance of the proposed methods is evaluated under various scenarios.

4 - A New Moment-based Method for Combining Heterogeneous Statistical Findings

Mohammad S. Jalali, PhD Student, Virginia Tech, Falls Church, VA, United States of America, mj@vt.edu, Kamran Paynabar, Hazhir Rahmandad

Currently meta-analysis and meta-regression are used for aggregating effect sizes from different studies. These methods are limited to homogeneous statistical studies with same design and independent and dependent variables. We introduce a new approach for aggregating statistical estimates coming from heterogeneous studies with different designs and functional transformations. We show the utility of the method by examples of extracting unbiased parameter values from biased regression results.

■ TB63

Mezzanine - 100D

The Modeling, Monitoring and Control of Systems using Complex Data (I)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Fadel Megahed, Assistant Professor, Auburn University, 3301L Shelby Center, Auburn, AL, 36849, United States of America, fmegahed@auburn.edu

Co-Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

1 - On Nonparametric Statistical Process Control

Peihua Qiu, Professor, University of Minnesota, Minneapolis, MN, United States of America, qiuxx008@umn.edu

We consider statistical process control (SPC) when the parametric form of the process distribution is unavailable. In the literature, some nonparametric SPC charts have been proposed based on the ordering information of the observed data. We present an alternative framework for constructing nonparametric control charts using categorical data analysis. This framework is demonstrated to work well in various applications.

2 - Statistical Analysis and Modeling of Wafer Variation

Lulu Bao, PhD Candidate, Tsinghua University, Department of Industrial Engineering, Beijing, 100084, China, baoll11@mails.tsinghua.edu.cn, Kaibo Wang

The aim of this work is to establish a statistical model for silicon wafer thickness which can be used to help monitor and control the quality of wafers. In the work, the failure mode of the wafer thickness data is discovered by statistics and analysis. And on that base, a model to describe wafer thickness is built. The within wafer variation is modeled using Gaussian Markov random fields while the wafer-to-wafer variation is reflected using the different changing directions of wafer thickness.

3 - Monitoring Wafer Geometric Quality using Additive Gaussian Processes

Nan Chen, Assistant Professor, National University of Singapore, 1 Engineering Drive 2, Singapore, 129789, Singapore, isecn@nus.edu.sg, Linmiao Zhang, Kaibo Wang

Wafer geometric quality is an important quality characteristic in the semiconductor industry. However, it is difficult to monitor the geometric quality due to the challenges raised from the complexity of the data structure. In this article, we propose an additive Gaussian process (AGP) model to approximate the standard wafer geometric profile while quantifying the normal deviations. Based on the AGP model, two statistical tests are developed to monitor the conformity of the wafers.

4 - Growing Profile Monitoring using Dynamic Time Warping

Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn, Ran Jin

This talk focuses on the monitoring of incomplete dynamic profiles with time-varying mean, variation and length. Taking the ingot growing process as an example, we propose to use dynamic-time-warping (DTW) to align profiles having different lengths first, and then compare online but incomplete profiles with a baseline profile for faults detection. Both numerical simulations and real examples are demonstrated for performance comparison.

■ TB64

Mezzanine - 100E

Contemporary Topics of Information Systems in the New Millennium

Sponsor: Information Systems

Sponsored Session

Chair: Tridib Bandyopadhyay, Associate Professor, Kenensaw State University, 1000 Chastain Road, Kennesaw, GA, 30144, United States of America, tbandyop@kennesaw.edu

1 - Optimal Allocation of Resources in Information Gathering and Container Screening for Port Security

Aniruddha Bagchi, Associate Professor, Kennesaw State University, 1000 Chastain Road, Kennesaw, United States of America, abagchi@kennesaw.edu, Jomon Paul

We develop a game theoretic model that analyzes the interaction of information (intelligence) gathering and screening in securing cargo containers in ports. We use this model to determine the impact of (i) improving the accuracy of screening and (ii) efficacy of programs like C-PAT that allows expedited screening to trusted importers. We find that an increase in the opportunity cost of time enhances the importance of information gathering.

2 - Security Risk Management in Healthcare: A Case Study

Humayun Zafar, Assistant Professor of Information Security and Assurance, Kennesaw State University, 1000 Chastain Road. MD 1101, Kennesaw, GA, 30144, United States of America, hzafar@kennesaw.edu

Effective security risk management (SRM) programs in organizations can help balance operational necessities and economic costs associated with IT-based systems. SRM is not a standalone activity; it should be integrated with all processes of an organization. The purpose of this study was to identify the perceived effectiveness of an existing security risk management program at a large healthcare institution.

3 - The Optimal Advertising Policy on Facebook

Anwesha Bhattacharjee, University of Texas at Dallas, 2200 Waterview Pkwy., Apt. 1836, Richardson, TX, 75080, United States of America, axb094820@utdallas.edu, Vijay Mookerjee

Advertisers on Facebook can control their advertising effort to maximize profit. This paper analyzes the optimal advertising strategy for firms on Facebook. The findings suggest that a firm with a bigger initial market will spend less on the campaign. Results also indicate there are distinct regions where Facebook's revenue decreases as sharing increases and Facebook has an opportunity cost for providing viral impressions to an advertiser for free.

4 - Defending Cyber Terrorism – A Game Theoretic Approach

Tridib Bandyopadhyay, Associate Professor, Kenensaw State University, 1000 Chastain Road, Kennesaw, GA, 30144, United States of America, tbandyop@kennesaw.edu, Aniruddha Bagchi

Internet connectivity to SCADA networks opens conduit for malicious attacks on critical infrastructure firms. Victim firms inability to provide service ripple through the economy and give rise to high aggregate loss. Our game theoretic model analyzes multiple equilibria in optimal defense against attacks from cyber terrorists. Role of intelligence and severity of punishment are analyzed on public-private participation for optimal defense against cyber terrorism.

■ TB65

Mezzanine - 100F

Understanding through Social Media

Cluster: Social Media Analysis

Invited Session

Chair: Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, United States of America, lservi@mitre.org

1 - Automatic, Near Real-time Event Detection in Twitter

Jared Mowery, The MITRE Corporation, McLean, VA, United States of America, jmowery@mitre.org

This project aims to explore the space of events that can be automatically detected in near real-time using Twitter data coupled with statistical analysis and machine learning techniques. The algorithms will be generalizable and semi-automated to enable rapid, cost-effective development of detectors in a variety of domains

2 - Machine Learning Applications in Social Media Analytics

Rick Lawrence, Manager, Machine Learning, IBM Research, Business Analytics & Mathematical Scienc, Yorktown Heights, NY, 10598, United States of America, ricklawr@us.ibm.com

We will discuss applications of machine learning to several challenges inherent in the analysis of social media including (a) prediction-based approaches to characterizing the influence of participants in a social media context, (b) combined lexical and machine-learned sentiment models, and (c) NMF-based techniques for extracting a lower-order topic space that best reconstructs a document corpus. We will also describe a current UNICEF project in classifying SMS text messages in Uganda.

3 - Understanding the Pulse of the Workforce through Social Media Text Analytics

Wermer Geyer, IBM Research Cambridge, Cambridge, MA, United States of America, Werner.Geyer@us.ibm.com, Stephen Levy

The use of social media within the enterprise is increasing and with it the availability of unstructured text data containing the public "voice" of the workforce. We present an application that helps make sense of unstructured data by applying text analytics methods (topic extraction, sentiment analysis, etc.) Combined with structured data from corporate directories, we can effectively filter and segment social data based on demographics to provide targeted insights into the workforce.

4 - Analysis of Trends in Time Series with Discontinuities

Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, United States of America, lservi@mitre.org

This talk develops a real time algorithm which identifies times of emotional discontinuity as reflected in social media. The talk formulates the optimization problem to solve, develops an algorithm to solve it using dynamic programming, and illustrates the new method by analyzing mood shifts reflected in 380,000 Twitter messages related to one of the most popular soccer teams, Manchester United, during their 2011-12 season.

■ TB66

Mezzanine - 100G

Theory and Application of Crowdsourcing

Sponsor: Information Systems

Sponsored Session

Chair: Qihang Lin, PhD Student, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, qihangl@andrew.cmu.edu

1 - Selective Sampling of Labelers for Approximating the Crowd

Haym Hirsh, Cornell University, Computing and Information Science, Ithaca, NY, United States of America, haym.hirsh@cornell.edu, Sergiu Goschin

We present CrowdSense, an algorithm for estimating the crowd's majority opinion by querying only a subset of it. CrowdSense works in an online fashion where examples come one at a time and it dynamically samples subsets of labelers based on an exploration/exploitation criterion. A weighted combination of a subset of the labelers' votes is produced to that approximate the crowd's opinion.

2 - Human-Powered Data Management

Aditya Parameswaran, Stanford University, 353 Serra Mall, Stanford, CA, 94305, United States of America, adityagp@cs.stanford.edu

Fully automated algorithms are inadequate for many data analysis tasks, especially those involving images, video, or text. Thus, we need to combine "human computation" (or crowdsourcing) with traditional computation, to improve the process of understanding, extracting and managing data. In this talk, I will present a broad perspective of our research on this topic. I will then present details of one of the problems we have addressed: filtering large data sets with the aid of humans.

3 - Statistical Decision Making for Optimal Budget Allocation in Crowdsourcing

Xi Chen, PhD Student, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, xichen@cs.cmu.edu, Qihang Lin, Dengyong Zhou

In this talk, we discuss an important statistical decision problem in crowdsourcing: the optimal budget allocation for labeling task. Using tools from Bayesian statistical decision theory, we formulate the allocation problem as a Bayesian Markov Decision Process (MDP). To address the computational challenge, we propose a new approximate policy, called optimistic knowledge gradient policy, which is a consistent policy and leads to superior empirical performance.

■ TB67

Mezzanine - 100H

Healthcare Applications in OR/MS I

Sponsor: Decision Analysis

Sponsored Session

Chair: Nasibeh Azadeh-Fard, PhD Student, Virginia Tech, 401 Fairfax Rd., Apt. No. 631, Blacksburg, VA, 24060, United States of America, azadehfard@gmail.com

1 - Quantifying the Impact of Overdiagnosis in Breast Cancer Screening

Paul Griffin, Professor, Pennsylvania State University, 310 Leonhard Building, Department of Industrial and Manufacturing, University Park, PA, 16802, United States of America, pmg14@engr.psu.edu, Sai Zhang

Screening programs have been effective at reducing mortality and in early stage detection of breast cancer. The presence of overdiagnosis in breast cancer screening, however, has a potential for harm. We quantify the impact of overdiagnosis on quality adjusted life years and expected number of mammograms over a lifetime under various screening policies. Recommended screening intervals based on a Markov-based model ranged from 2 to 3 years depending on conditions.

2 - Coordination Strategies in Blood Supply Chains

Paronkasom Indradat, PhD Student, Pennsylvania State University, Department of Industrial and Manufactur, 310 Leonhard Building, University Park, PA, 16802, United States of America, pxi5005@psu.edu, Paul Griffin

Discrete event simulation models are developed to compare the implementation of vendor managed and recycle policies for the distribution of red blood cells between blood centers and hospitals. Experimental results show that the proposed strategies outperform the baseline by reducing the number of outdates by up to 70%. Further, the order quantities can be reduced by up to 67% without increasing the number of shortages.

3 - An Operations Research Modeling of Incorporating Causes and Consequences of Work-related Health Problems

Ahmad Sobhani, PhD Candidate, Ryerson University, 350 Victoria Street, Toronto, ON, M5B 2K3, Canada, asi.sobhani@gmail.com, M.I.M. Wahab, Patrick Neumann

Causes and consequences of an employee's performance variations due to the work-related Musculoskeletal injuries infrequently investigated in optimizing the performance of operation systems. This research first considers the effect of working environment aspects of an operation system by using a health-related Markov chain for each employee, and then optimizes the system performance under stochastic demand.

■ TB68

Mezzanine - 100I

Validating Models of Adversary Behavior

Sponsor: Decision Analysis

Sponsored Session

Chair: Jun Zhuang, Assistant Professor, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, United States of America, jzhuang@buffalo.edu

1 - Validation of Adversary Utility Assessment by Proxy

Richard John, Associate Professor, University of Southern California, Department of Psychology, MC-1061, Los Angeles, CA, 90089-1061, United States of America, richardj@usc.edu, Heather Rosoff

We report two validation studies comparing MAU models for two different politically active non-profit organizations that utilize civil disobedience to achieve political objectives. In both cases, we demonstrate good convergence between the proxy model and the model assessed by direct contact with a stakeholder representative.

2 - Beyond Risk-neutrality in Attacker-defender Games

Victor Richmond Jose, Georgetown University, McDonough School of Business, Washington, DC, United States of America, vrj2@georgetown.edu, Jun Zhuang

Traditional models of attacker-defender (AD) games typically assume that players are risk-neutral. Behavioral research however has shown that individuals often violate risk-neutrality. In this talk, we consider how the use of alternative decision making frameworks, namely expected utility and prospect theories, affects the equilibrium behavior of players in AD games. We then demonstrate how certain results may no longer hold when risk-neutrality is dropped in favor of these theories.

3 - Combining Prescriptive and Descriptive Decision Theory in Counter-terrorism

Jason Merrick, Professor, Virginia Commonwealth University, Richmond, VA, United States of America, jrmerric@vcu.edu, Philip Leclerc

Recent methods in counter-terrorism find the attacker's optimal decision attacker as well as the defender, where both are faced with uncertainty about the outcomes. If we solve for the optimal attacker decision using subjective expected utility, we are implicitly ignoring biases that humans exhibit in making decisions under uncertainty, like gain-loss effects and probability neglect. We model the attacker's decisions using cumulative prospect theory and examine several potential in this context.

4 - Learning Attacker Strategies in Security Games

Albert Xin Jiang, University of Southern California, Dept of Computer Science, Los Angeles, CA, 90089, United States of America, albertjiang@gmail.com, Yundi Qian, Albert Xin Jiang, Emma Bowring, Elizabeth Denicola, Joseph DiRenzo

Previous work on Security Games has mostly focused on domains where the payoff matrix is known to both the defender and the attacker. However, in many real world domains, the defender may have few ideas about the attacker's payoffs, which is a big issue for the defender when designing her strategies. Fortunately, multiple rounds of plays provide the defender the opportunity to "learn" those payoffs. In our work, we develop models and efficient algorithms to deal with this new challenge.

5 - Modeling and Validating Multi-period, Multi-type, and Multi-target Attacker-defender Games

Jing Zhang, University at Buffalo, 338 Bell Hall, Buffalo, NY, United States of America, jzhang42@buffalo.edu, Jun Zhuang

We present a novel class of multi-period and multi-target attacker-defender games where the attacker has multiple attacking types including assassination, armed assault, bombing/explosion, facility/infrastructure attack, hijacking, and hostage taking. We validate this model using terrorism and defensive investment data including Global Terrorism Database and Urban Areas Security Initiative programs. This research provides some new insights on modeling and validating models of adaptive adversary.

■ TB69

Mezzanine - 100J

Marketing II: Customer Characteristics and Marketing Strategies

Contributed Session

Chair: Pranjal Mallick, Project Manager, Hewlett-Packard, No. 66/2, Ward No. 83, Bagmane Tech-Park, Wing A, Embassy Prime, CV Raman Nagar, Bangalore, 560093, India, pranjal.mallick@hp.com

1 - The Role of Reward Structure in the Effectiveness of Customer Loyalty Programs

Amir Gandomi, Instructor, Ryerson University, 350 Victoria Street, Toronto, ON, M5B 2K3, Canada, agandomi@ryerson.ca, Saeed Zolfaghari

This study analyzes multitier loyalty reward schemes in which the reward value depends on the purchase frequency. Customers' decision to buy is a function of their valuation and current and future prices and rewards. Valuation is incorporated as a stochastic variable. The objective is to maximize the firm's profits, which yields a nonlinear programming problem. The results show that the multitier rewards, compared to the single-tier rewards, brings higher profits from the heavy-user segment.

2 - The Impact of Subjective and Objective Fit on Brand Extension Success

Irene Nahm, Student, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, 151-916, Korea, Republic of, reney@snu.ac.kr, Jing Gyo Kim

This paper develops an empirical model to investigate the impact of brand extension on subjective and objective fit. Variety of fit are categorized into two distinct fit; subjective fit measures the similarity in image, symbol, and personality while objective fit measures the similarity of the category of the brand. Then the author proposes a model in which brand extension success, or dilution, can be affected by subjective and objective brand fit.

3 - Customer Lifetime Value Modeling in Semi-contractual Setting

Rui Cai, Beijing University of Posts and Telecommunications, School of Economics and Management, Room 403, Building 10, Xitucheng Road, Haidian District, Beijing, China, ruicai1989@gmail.com, Jiayin Qi

Semi-contractual setting is a new concept in customer lifetime value (CLV) modeling. While studying on telecom customer relationship management, we found another kind of semi-contractual setting. In this setting, a customer's survival time is factitious truncated. We tried to create a new CLV model by first proposed the BG-t/BB model for customer base analysis and then used the Gamma-Gamma model to forecast customers' monetary value. The empirical results showed model's good forecasting effects.

4 - A Non-linear Optimization Framework for Demand Estimation of HP's Products and Services

Pranjal Mallick, Project Manager, Hewlett-Packard, No. 66/2, Ward No. 83, Bagmane Tech-Park, Wing A, Embassy Prime, CV Raman Nagar, Bangalore, 560093, India, pranjal.mallick@hp.com, Vikash Kumar Sharma

What is the opportunity? Ó is the foremost question in the minds of marketing managers while optimizing 'go to market' strategies, allocating sales resources and thereby driving revenue growth. The proposed methodology is a demand estimation framework based on a non-linear optimization model. The estimates are computed for the entire spectrum of HP products and services encompassing company hierarchy from individual accounts, sites and divisions to global entities like Fortune 100 companies.

■ TB70

Mezzanine -101A

Performance and Optimization in Surface Operations Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Yi Liu, University of California, Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com

1 - Factors Enabling Single Engine Taxi Procedures at Airports: Case Studies with Airline Data

Megan Ryerson, Assistant Professor, University of Tennessee, Department of Civil and Environmental En, 113 Perkins Hall, Knoxville, TN, 37996, United States of America, mryerson@utk.edu, Dua Abdelqader

While fuel savings can be achieved through single engine aircraft taxi procedures, such procedures are not consistently utilized. We investigate how runway configurations, crossings, and taxi distance factor into the decision to perform a single engine taxi. From the statistical analysis utilizing actual airline fuel consumption data we find enablers of single engine taxi to be a relatively long taxi distance, full information about taxiway congestion, and runways dedicated to departures.

2 - Real-time Integrated Airport Surface Controlling Model

Qing Wang, University of South Florida, 4202 E. Fowler Ave., ENC 3300, Tampa, FL, 33620, United States of America, qingwang@mail.usf.edu, Yu Zhang

In this study, we propose a real-time integrated airport surface movement controlling model. Given a set of arrival and departure flights in a specified planning horizon, the model determines 4D trajectories of aircraft that minimizes total taxi time and maximize runway throughput subject to operational constraints and safety requirements. The main decision variables include the push-back time at gates, passage time of aircraft in taxiways, and the ordering of landing and takeoff flights.

3 - Stochastic Program for Setting Pushback Times in the Presence of Uncertainties

John-Paul Clarke, Associate Professor, Georgia Tech, 270 Ferst Drive N.W., Atlanta, GA, 30332-0150, United States of America, johnpaul@gatech.edu, Su Won Bae

There is great uncertainty in the trajectory of an aircraft on the airport surface. Thus it is impossible to determine with certainty how a given pushback schedule will "translate" to a sequence of departures and the schedule of operations at the runway. We determine the pushback schedule that results in the best "expected" realization of runway operations via a stochastic program in which ramp, taxiway, and terminal area uncertainties are considered along with the potential recourse actions.

■ TB71

Mezzanine -101B

Advances in Game Theory

Contributed Session

Chair: Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15232, United States of America, sandholm@cs.cmu.edu

1 - A Cooperative Dual to the Nash Equilibrium

Bill Corley, Professor, The University of Texas at Arlington, Box 19017, Arlington, TX, 76019, United States of America, corley@uta.edu

A cooperative dual to the Nash Equilibrium (NE) is presented. In an NE every player chooses an equilibrium strategy to maximize his own payoff for the remaining n-1 players' strategies. The Dual Equilibrium (DE) is based on cooperation, where every n-1 players have equilibrium strategies that maximize the remaining player's payoff, an approach that raises questions on the limits of cooperation.

2 - The Maximum Principle for Global Solutions of Stochastic Stackelberg Differential Games

Shaokuan Chen, The University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, sk.chern@gmail.com, Suresh Sethi, Alain Bensoussan

We derive the maximum principle for the leader's global Stackelberg solution under the adapted closed-loop memoryless information structure, where the term global signifies the leader's domination over the entire game duration. As illustrative examples, we study linear quadratic Stackelberg games under both adapted open-loop and adapted closed-loop memoryless information structures.

3 - Can Adversarial Risk Analysis Define a New Equilibrium Concept in Games?

Joao Jose de Farias Neto, Dr., Instituto de Estudos Avançados, CTA, Trevo Cel Av. J.A.A. Amarante, n. 1, Putim, São Jose dos Campos, SP, 12.228-001, Brazil, joaojfn@ieav.cta.br

Choosing game strategy based on a finite number of mirror reasonings (the so called level-k approach) has been proposed in the recent literature. If the proposed strategies converge as k->oo, a new equilibrium concept in games could be defined that would have a simplicity advantage over the existing ones in complicated games. This article examines some simple cases and concludes that there are classes of games in which such a new equilibrium concept is possible and classes in which it isn't.

4 - On Lagrangian Relaxation Based Cost Allocations for Operations Research Games

Lindong Liu, HKUST, IELM Department, Hong Kong, Hong Kong - PRC, njulld@gmail.com, Xiangtong QI

In this work, we will develop a new method of computing good cost allocation for operations research games. This method is based on Lagrangian relaxation, column generation and sub-modular function minimization techniques. Computational implementations have been carried out based on facility location games.

5 - Finding Strong Nash Equilibrium (SNE)

Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15232, United States of America, sandholm@cs.cmu.edu, Marco Rocco, Nicola Gatti

In an SNE, no coalition can deviate so all colluders benefit. We prove that verifying SNE is in P (for fixed number of agents). We present the first algorithms for SNE finding in normal form games. For 2-agent games we design two: a branch and bound, and a constraint addition algorithm. We derive necessary/sufficient constraints for SNE in n-agent games. We design a branch and bound that uses them at nodes. Experiments show the benefits. We prove SNE finding, unlike Nash, is in smoothed P.

■ TB72

Mezzanine -101C

Financial Network and Systemic Risk

Cluster: Risk Management

Invited Session

Chair: Nan Chen, Associate Professor, The Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk

1 - Filtered Likelihood for Point Processes

Gustavo Schwenkler, Boston University, 595 Commonwealth Ave., Boston, MA, 02215, United States of America, gschwenk@stanford.edu, Kay Giesecke

We develop likelihood estimators of the parameters of a point process and of incompletely observed explanatory factors that influence the arrival intensity. The factors follow general stochastic processes and may depend on the point process. We provide conditions guaranteeing consistency and asymptotic normality as the sample period grows. We also establish an approximation to the likelihood and analyze the properties of the associated estimators. Numerical results illustrate our approach.

2 - Interconnected Balance Sheets, Market Liquidity, and Amplification Effects in a Financial System

Nan Chen, Associate Professor, The Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk, David Yao, Xin Liu

This paper investigates the amplification effect of a financial system to develop individual defaults to a systemic catastrophe. We develop a network-based approach to characterize how the topological structures of the system and asset liquidation interact with each other to amplify the systemic risk. We propose two multipliers, network multiplier and liquidity multiplier, to characterize the above amplification effects.

3 - A Continuous Time Stochastic Model for Spread-price Dynamics in Order-driven Markets

Xinyun Chen, Columbia University, Room 323 Mudd Building, 500 West 120th Street, New York, United States of America, xc2177@columbia.edu, Jose Blanchet

We construct and study a continuous time model that incorporates the whole limit order book to inform the joint evolution of the spread and the price processes. The construction of our model is guided by empirical data. In particular, empirical observations suggest a multi-scale asymptotic regime, under which we obtain a jump-diffusion processes governing the evolution of the spread-price dynamics. The simulation results reproduce stylized features observed empirically.

4 - Systemic Risk in Asset-investor Networks

Garud Iyengar, Professor, Columbia University, IEOR Dept., New York, NY, United States of America, garud@ieor.columbia.edu, Ciamac Moallemi, Chen Chen

In this talk we will present a model that explores systemic risk in asset-investor networks. The source of systemic risk in our model is contagion via the endogenous price that is determined by the trades of the investors coupled with the market clearing. We identify two different mechanism for this contagion — the first is the wealth effect, and the second is a portfolio re-balance effect.

Tuesday, 12:30pm - 2:30pm

■ Interactive Session

Exhibit Hall D

Tuesday Interactive Session

Cluster: Interactive Sessions

Invited Session

Chair: Jeff Linderoth, University of Wisconsin, Milwaukee, WI, United States of America, linderoth@wisc.edu

1 - Rationing Policy under Service Level Constraint and Continuous Stochastic Demand

Pablo Escalona, MsC Industrial Engineer, Universidad Tecnica Federico Santa Maria, Avenida España 1680, Valparaiso, Chile, pablo.escalona@usm.cl, Fernando Ordoñez

This paper analyzes the critical level policy as a mechanism to provide differentiated service-levels (SL) when the inventory system works under a continuous review policy (Q,r) and the demand class is modeled through a continuous distribution. In order to find the optimal parameters ,a SL problem is raised and the characteristics of the system are determined through the hitting time. Structural properties are derived from the SL constraints that allow the construction of an algorithm.

2 - Measuring Network Effect in Resort Revenue Management Systems

Haining Yu, Walt Disney Parks Resorts, Lake Buena Vista, FL, United States of America, haining.yu@disney.com, Tianke Feng, Hai Chu, Frederick Zahrn

We propose a novel method to measure the impact of network effect in resort revenue management systems. Resort network effect is determined by level of demand, length of stay, capacity, among other things. By accurately measuring network effect, we can improve the design and configuration of revenue management algorithms.

3 - Decision Support System to Schedule Coffee Shop Servers

Chijioke Ifepe, North Dakota State University, 88 University Village, Fargo, ND, United States of America, chijioke.ifepe@ndsu.edu, Joseph Szmerekovsky, Vinay Gonela

The scheduling of coffee shop is a complex problem where the manager spends significant amount of time to develop weekly schedule of the servers. In this work, a decision support system (DSS) is designed that makes the scheduling process easy and less time consuming.

4 - Estimating the Missing Values in Two Way Tables by Artificial Neural Networks and Fuzzy Regression Models using Normal and Non-normal Data Set

Farzad Radmehr, West Virginia University, 1231 Van Voorhis Rd., Apt. F, Morgantown, WV, 26505-3446, United States of America, fradmehr@mix.wvu.edu, Azadeh Ansari, Javad Rahimikollu

Estimating the missing value is a common problem in many industries and finding an approach to treat the problem is critical, because it can guarantee the quality of results. In this paper, we use two-way tables from real industries, so we are working with real data and not randomly generated datasets, using the real data can increase the accuracy of the studies. The Normal and Non-normal data sets has been considered and Artificial Neural Networks (ANN) and fuzzy regression methods were applied to solve the problem. The research shows that proposed ANN approach can produce the best results in normal and non-normal data sets. Especially, in non-normal data sets, the ANN results are very close to actual data compared with other techniques, because ANN has a capacity to insert the normalization step in the algorithm. Figures 3 and 4 show analysis and proposed tables show the efficiency of each technique in all data sets.

5 - A First Order Method for Large Scale Choice Probability Prediction with Correlated Random Utilities

Xiaobo Li, Research Assistant, Singapore University of Technology and Design, 20 Dover Drive, Singapore, Singapore, lixiaobo87@gmail.com, Selin Ahipasaoglu, Karthik Natarajan

Computing the choice probabilities in a Multinomial Probit model is a computational challenge when the number of alternatives is large. The Cross Moment Model (CMM) is a recently proposed semidefinite program to compute choice probabilities with correlations. We develop an efficient first order gradient ascent method to compute choice probabilities in CMM. Numerical results show that this method can compute choice probabilities for 4000 alternatives in less than an hour.

6 - Classification using Tree Structures

Garebangwe Mabe-Madisa, Lecturer, Unisa, Club One, Pinaster & Deli Streets, Pretoria, GP, 0184, South Africa, mabemgv@unisa.ac.za

The poster describes the variation (the structure of a taxpayer). Statistical Pricinpal Component Analysis (PCA) is used to analyse the variation and the best variables are selected. Data Envelopment Analysis (DEA) is then used to analyse the efficiency and the best algorithms selected. An ensemble algorithm tree is constructed and data classified with the objective of optimizing accuracy.

7 - Modeling Maximum Wind Speed and Minimum Central Pressure in Atlantic Tropical Cyclones

Lindsey Dietz, Statistics PhD Student, University of Minnesota, 313 Ford Hall, 224 Church Street SE, Minneapolis, MN, 55455, United States of America, diet0146@umn.edu, Snigdhansu Chatterjee

Prior research suggested the relationship between minimum pressure and maximum wind speed in a tropical cyclone can be described by a physical model. We tested this model using elementary and advanced statistical techniques. The physical model was a good first order approximation of the relationship, however, due to the heteroskedastic nature of the data, our research found that a more sophisticated model was necessary to develop an understanding of the relationship and to aid in prediction.

8 - An Agent-based Modeling of the Multimodal Near-field Tsunami Evacuation

Haizhong Wang, Assistant Professor, Oregon State University, 220 Owen Hall, Corvallis, OR, 97330, United States of America, haizhong.wang@oregonstate.edu, Shangjia Dong

The goal of this research is to investigate the impacts of different evacuee decision-making time on the estimation of casualties in a multi-modal tsunami evacuation. The results of this research will improve the emergency evacuation planning and operation of Long Beach Peninsula which is potentially subject to significant tsunami hazards.

9 - Dynamic Facility Location and the Value of Inventory Mobility in Disaster Relief

Amber Richter, University of California, 4141 Etcheverry Hall, Berkeley, CA, 94720, United States of America, amberr@berkeley.edu, Zuo-Jun Max Shen

This research explores the dynamic relocation of pre-positioned inventory for responding to disasters over time. This poster presents dynamic programming models used to develop insights on the value of inventory mobility in disaster relief.

10 - Problem-based Branching Priority Lists in the Branch-and-cut Tree for Stochastic Unit Commitment

Amy Pielow, Ohio State University, Baker System Engineering, 1971 Neil Ave., Columbus, OH, 43210, United States of America, pielow.1@osu.ede, Ramteen Sioshansi

The authors derive knowledge-based branching rules for the branch-and-cut tree specific to the large-scale, stochastic unit commitment model being solved. These user-given lists are compared to the default branching decisions made by the solver and are found to perform branching up to twice as quickly with fewer nodes.

11 - A Multiple Stage Optimization for Developing Hydrogen Refueling Infrastructures in Northeastern U.S.

Hossein Abdollahnejadbarough, Northern Illinois University, 590 Garden Road, EB230, Dekalb, IL, 60115, United States of America, hossein.abdolahnejad@gmail.com, Sukgon Kim, Kevin B. Martin

An initial hydrogen vehicle supply network for the Northeastern U.S. is designed which includes the metropolitan areas of Boston, Philadelphia, Washington D.C. and New York City. A new formulation for modeling the congestion and capacity of the refueling stations along with strong heuristics and exact solution methods are presented. Stochastic demands are extracted from U.S. census tract data using predictive analytics and a Geographical Information System (GIS) software program.

12 - Optimization of Energy Management in Smart Grid

Sunil Vuppala, IIITB, Electronics City, Bangalore, 560100, India, sunil.vuppala@iiitb.ac.in, G N Srinivasa Prasanna

We address modeling methodologies to handle large scale power grid energy management problems and its solution methods. Even a 1000-customer problem each having 10 appliances with 10 supply options and RTP results in MILP with millions of variables. The convexified model is solved by nested simulation and optimization using Cplex both at consumer and utility levels. We show the applicability of quadratic programming.We will present system dynamics and computational issues with practical systems.

13 - Combining Estimates of Conditional Treatment Effects

Craig Rolling, Statistics PhD Candidate, University of Minnesota, 313 Ford Hall, 224 Church St. SE, Minneapolis, MN, 55455, United States of America, crolling@umn.edu

We introduce a model combination strategy for the purpose of estimating the conditional effect of a treatment given covariates. We provide a bound for the risk of the resulting estimator under squared error loss and show that it often provides more accurate treatment effect estimates than other model selection and combination methods.

14 - A MDP Model for Breast and Ovarian Cancer Intervention Strategies for BRCA1/2 Mutation Carriers

Mehrnaz Abdollahian, PhD Student, University of South Florida, 2038 Gregory Drive, Tampa, FL, 33613, United States of America, mehrnaz@mail.usf.edu, Tapas Das

Women who inherit BRCA1/2 mutations have higher risk for breast and ovarian cancers. Available intervention actions to reduce risk of cancer include prophylactic surgeries and breast screening. These actions vary significantly in cost and offer different levels of risk reductions for cancer incidence. We develop a Markov decision process (MDP) model to obtain effective intervention strategies comprising surgery and screening options.

15 - Using EMR Data for Prediction of Poor Medication Adherence

Sergey Blok, Booz Allen Hamilton, One Preserve Parkway, Rockville, MD, United States of America, blok_sergey@bah.com, Ernest Sohn

We tested the feasibility of using data mining and analytic techniques on electronic medical records (EMR) data, using data provided by MedMining. To demonstrate proof-of-concept, we leveraged data visualization techniques to explore patient- and population-level data elements and developed a predictive model for poor medication adherence. We discuss implications of leveraging EMR data in improving adherence and more broadly, quality of care.

16 - Cost-effectiveness Analysis of Screening for Type II Diabetes in China

Hannah Fan, Stanford University, 44 Olmsted Rd., #408, Stanford, CA, 94305, United States of America, fancc@stanford.edu, Edison Tse

Diabetes mellitus is one of the most common chronic diseases in China. Currently,the age-standardized prevalence of diabetes and prediabetes were 9.7% and 15.5%. Moreover, more than half of the total diabetes cases were previously undiagnosed. Therefore, the purpose of this study is to model the disease progression processes and identify the most cost-effective screening strategies for T2DM. The preliminary research results indicated that screening age group 45-54 was the most cost-effective.

17 - From Check 21 to Mobile Payment: A Natural Evolution

Hongwei Du, Professor, California State University, East Bay, 25800 Carlos bee Blvd, Hayward, CA, 94542, United States of America, hongwei.du@csueastbay.edu

In 2004, the Check 21 Act was implemented in the US to authorize conversion of paper check into an electronic image for processing. Yet a relatively new form of payment is gaining in prominence: mobile payments. I focus on two specific forms of mobile payments: Google Wallet and Square. I analyze the potential risks involved in mobile payments: fraud, security, identity theft, and privacy. It is evident that mobile payments are rapidly gaining in popularity amongst businesses and customers.

18 - Safety Stock Optimization in Assembly Systems under Long and Highly Variable Supplier Lead Times

Michael Prokle, PhD Candidate, University of Massachusetts Amherst, 8 Coach Lane, Amherst, Ma, 01002, United States of America, mprokle@acad.umass.edu, Ana Muriel, Faried Beladi, Rajesh Subbu

Supplier lead times in low-volume, high-tech industries are long and highly variable due to the inherent complexity of the product. We develop a stochastic programming optimization model to minimize component inventory holding while achieving a desired expected customer service level of the final product. A simulation study suggests a 60 percent cost improvement.

19 - Line Quality Characterization of Aerosol Jet Printing by Image Analysis

Yung-Hang Chang, Graduate Research Assistant, Georgia Institute of Technology, 813 Ferst Drive, N.W., Atlanta, GA, 30332, United States of America, purmac@gatech.edu, Kan Wang, Chuck Zhang, Ben Wang

Line quality of Aerosol Jet printed electronics is essential to their performance but currently not effectively controlled. A set of quality indices based on image analysis are proposed to describe the quality of printed lines and the relationship between those indices and line resistivity has been investigated. The results of this study have established the basis for further research on process modeling and optimization to improve robustness of Aerosol Jet printing technology.

20 - United States Coast Guard Air Station Simulator

Christie Nelson, Rutgers University, CCICADA, 96 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, christie.l.nelson.phd@gmail.com, Matt Oster, Fred Roberts, Thomas Sharkey, Terence Vaughn, Curtis McGinity, Paul Kantor, Endre Boros, Chad Conrad, Kevin Hanson, Michael Lehocky

A simulation has been created for the United States Coast Guard of the Air Stations. Modeled from actual data, aircraft can be performing missions and receiving scheduled or unscheduled maintenance. The model simulates random Search and Rescue events to model the probability of meeting these mission hours.

21 - Development of a Web-based Decision Support Tool for Adaptive Management of Natural Resources

Victoria Hunt, Adaptive Management Project Coordinator, Chicago Botanic Garden, 1000 Lake Cook Road, Glencoe, IL, 60022, United States of America, vhunt@chicagobotanic.org, Clint Moore, Eric Lonsdorf, Sarah Jacobi

Adaptive management is a decision analysis approach that uses competing models to reduce uncertainty. The divide between technical tools and monitoring databases in adaptive management impedes its application in natural resource management. We present a web-based decision support tool bridging that divide for the US Fish and Wildlife Service's Native Prairie Adaptive Management project.

22 - Multi-stage Testing in New Product Development (NPD)

Fang Cui, Xi'an Jiaotong University, School of Management, PO Box 1850, Xi'an, China, 15091054888@139.com, Wentian Cui, Jun Lin

Testing is essential and multi-stage design mode is popular in NPD. Previous studies often ignore two typical features of multi-stage design process (MDP). This paper presents an analytical model for scheduling of tests in MDP. We derive optimal stopping rules for each stage' testing and the impact of different model parameters, such as redesign cost, the reliability between upstream and downstream, problem-solving capacity, opportunity cost, and the level of quality on the optimal solution.

23 - Mitigating Supply Uncertainty: Increase Capacity or Improve Reliability?

Wenting Pan, Saint Mary's College of California, 380 Moraga Road, Moraga, CA, 94556, United States of America, wp3@stmarys-ca.edu, Candice Huynh

We examine a supply chain with one retailer and one manufacturer. The manufacturer faces supply uncertainty, and any unmet order quantity; the retailer must source from a secondary supplier with higher costs. To mitigate supply uncertainty, the retailer can use their capital to invest in either increasing the manufacturer's capacity or improving the manufacturer's reliability. We explore the conditions under which particular strategy is preferred.

24 - Generalizations of Continuous Mixing Set: Extended Formulations and Facets

Manish Bansal, PhD Student, Texas A&M University, Department of Industrial and Systems Eng, 3131 TAMU, College Station, TX, 77840, United States of America, bansal@tamu.edu, Kiavash Kianfar

We present our progress in studying some interesting generalizations of the well-known continuous mixing set. We develop extended formulations and new facet-defining inequalities for these sets. We also present exact separation algorithm for the developed cuts and computationally evaluate the effectiveness of these cuts for multi-module lot-sizing problems with(out) backlogging.

25 - Generic Decomposition-based Methods for Mixed Integer Programming

Ted Ralphs, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, ted@lehigh.edu, Jiadong Wang

Decomposition methods for solving mixed integer linear optimization problems have been widely used to solve problems with well-understood structure. We discuss methods for automatically decomposing a given model and exploiting the decomposition in a parallel solution framework.

26 - A Quadratic Cone Relaxation-based Algorithm for Linear Programming

Mutiara Sondjaja, Graduate Student, Cornell University, 206 Rhodes Hall, Ithaca, NY, 14853, United States of America, msondjaja@gmail.com

We present and analyze a linear programming algorithm based on replacing the non-negative orthant with larger quadratic cones. For each quadratic relaxation that has an optimal solution, there naturally arises a parameterized family of quadratic cones for which the optimal solutions create a path leading to the LP optimal solution. We show that this path can be followed efficiently, thereby resulting in an algorithm whose complexity matches the best bounds proven for interior-point methods.

27 - On Robust Fixed-hub Single Allocation Problem

Dongdong Ge, Shanghai Jiao Tong University, 535 Fa Hua Zhen Road, shanghai, 20052, China, dongdong@gmail.com, Lai Wei

We consider a robust approach for the fixed hub single allocation problem with the uncertain demands. We propose a second order cone programming relaxation and a quick rounding method to solve the problem quickly.

28 - Performance Assessment of R&D Units of a Holding Company

Zahra Sharafi, West Virginia University, 1501 University Ave., Morgantown, WV, United States of America, z.sharafi.a@gmail.com, Mohsen Tavangar

R&D units as an integrated network play strategic roles affecting the entire company that requires a change from simple control structure to a set of complex coordination structure. The purpose is to present a conceptual and quantitative model to evaluate and compare the performance of R&D units of a holding company, involving a power-sector holding and its subsidiaries. Measurement was done by two main dimensions: infrastructural aspects and results of R&D investments.

29 - A Dynamical Systems Approach for Policy Modeling to Combat the Cradle to Prison Pipeline

David McMillon, Graduate Student, University of Michigan (Ann Arbor), 790 Belair Drive, Saginaw, MI, 48638, United States of America, mcmillon@umich.edu, Carl Simon

Activists refer to the process of those in impoverished neighborhoods turning to crime as the "cradle-to-prison pipeline." Here we study this process from a systems perspective under consultaton with practitioners and social scientists. Accounting for the effects of recidivism and criminal records, we derive conditions for the global asymptotic stability of a low-crime equilibrium by constructing Lyapunov functions. We include a sensitivity analysis of various intervention parameters.

30 - Implementation of Cross-training for a Multi-shift Worker Allocation Problem

Aditya Gandhi, Graduate Research Assistant, Rochester Institute of Technology, 1 Lomb Memorial Drive, Rochester, NY, 14623, United States of America, adg2351@rit.edu, Scott Grasman, Shrikant Jarugumilli

Worker allocation gaps associated with multi-shift manufacturing scenarios can be reduced by integrating cross-training and allocation procedures using mixed integer programming. The results display the worker assignment and training schedules on a shift-by-shift basis. This acts as a planning tool that assists in reduction of allocation gaps and idle time.

31 - A Spatio-Temporal Mixture Model for Point Processes with Application to Ambulance Demand

David Matteson, Assistant Professor, Cornell University, 1196 Comstock Hall, Ithaca, NY, 14853, United States of America, matteson@cornell.edu

We estimate spatio-temporal ambulance demand in Toronto, Canada at high resolution, which is critical for fleet management and deployment. We introduce a parsimonious Bayesian approach for modeling point processes via a time series of finite mixture models. Extensions include constraining the mixture weights to model seasonality, autoregressive priors on location-specific weights, integrating a spatial boundary, and a birth-and-death MCMC algorithm to estimate the number of components.

32 - Operational Performance Presages Value-chain Performance: Internal to External Carbon Emissions

Ozgur Isil, Doctoral Candidate, University of Wisconsin-Madison, 975 University Ave., Madison, WI, 53706, United States of America, isil@wisc.edu, Mark P. Finster

Sustainability strategy seeks reduction in carbon emissions. Using recent emission data, we demonstrate empirically that operational carbon emission performance predict value chain carbon reporting. The study extends OR theory by providing further evidence that internal integration enables external value-chain integration.

33 - Analysis of Risk in a Supply Chain System in the Presence of Damage Costs

Samir Alsobhi, PhD Student, Wichita State University, 11344 E. Pine Meadow Ct, Wichita, KS, 67206, United States of America, saalsobhi@wichita.edu, Krishna Krishnan, Abdulaziz Almaktoom

In a supply chain system, products get damaged during transportation. The damage loss can be reduced by selecting the appropriate packaging, transportation method, and by shipping under assembled or unassembled condition. An OR model which minimizes the damage costs, shipping costs, and packaging costs has been developed to address the issue of damage costs. A Case study to illustrate and validate the procedure is also shown.

34 - Modeling Water Needs in Western North Dakota

Christopher DeHaan, North Dakota State University, 1616 12th Ave. N., UGPTI-room 217, Fargo, ND, 58102, United States of America, christopher.dehaan@ndsu.edu

Water is a critical commodity in the Western US, and North Dakota is no different. With the need for water due to the hydraulic fracturing process used to acquire the shale oil of the Bakken Formation, as well as the increased populace, the demand on the water supply has increased. The water network is critical in assessing the needs of the region.

35 - Sensor Allocation Along a Freeway Corridor for Travel Time Reliability Measurement

Yanru Zhang, University of Maryland, College Park, MD, 20740, United States of America, yrzhang@umd.edu, Ali Haghani

For many intelligent transportation systems applications, detecting traffic conditions in a timely manner is critical for making real-time and effective control strategies. Reliable and accurate traffic information depends on the effective deployment of roadway sensors. This requires a careful selection on the number and locations of sensors before their deployment. This paper proposed a scheme to optimal allocates Bluetooth sensors to obtain reliable travel time along freeway corridors.

36 - Robust Approach to Solving Optimization Problems in Indian Rail and Road

Abhilasha Aswal, PhD Candidate, International Institute of Information Technology, Bangalore, 26/C Electronics City, Bangalore, 560100, India, abhilasha.aswal@iiitb.ac.in, G N Srinivasa Prasanna, Anushka Chandrababu

Our work deals with solving fleet scheduling problems in rail-road transportation networks using a robust optimization based approach. With our polyhedral specification of uncertainty, our models are tractable for realistic scale problems. In addition, we have heuristics for trip merging to find more efficient schedules, which is a generalization of the subset-sum problem. We present our work with KSRTC, a state owned road transportation company in India and Indian Railways.

37 - Dynamic Routing Model for Large Urban Lab Collection Networks

Luke Holt, PhD Candidate, North Dakota State University, 7084 148th Ave. NE, Grafton, ND, 58237, United States of America, luke.holt@ndsu.edu, Joseph Szmerekovsky, Sumadhur Shakya

We study a large scale lab specimen collection network involving hospitals, clinics, and long-term care facilities. Supply chain couriers visit many sites without lab specimen pickup or product delivery. We present a vehicle routing model to dynamically schedule vehicle routes updated in real-time from lab specimen and dispatch log requests.

38 - Implementation of Dynamic Routing for 300-mm Semiconductor Fabs

Junho Lee, Georgia Institute of Technology, Atlanta, GA, United States of America, junholee@gatech.edu, George Nemhauser, Shabbir Ahmed, Kelly Bartlett, Joel Sokol

In rail-based Automated Material Handling Systems (AMHS), such as those used to transport wafers in semi-conductor manufacturing, vehicular congestion results in reduced production efficiency. We present vehicle routing strategies to prevent congestion including dynamic routing, where routes are adjusted based on current congestion, and intentional route distribution using a multi-commodity flow model. We provide results from a simulated prototype facility.

39 - A Tree-based Product Attribute Redundancy Removal and Similarity Calculation Algorithm

Z. Maria Wang, Oracle, Reston, VA, United States of America, z.maria.wang@gmail.com, Su-Ming Wu, Alex Kushkuley

Proposed is a tree algorithm that is devised to remove the information redundancy in retail product attributes and their values, based on which product similarity is calculated to support an end retail analytics products such as Consumer Decision Tree (CDT), Demand Transference (DT) etc. To the best of our knowledge, we haven't seen any closely related or similar work published for using a tree algorithm to understand the association relationship among categorical product attributes and literally none for how to detect and remove information redundancy among attributes.

40 - Optimal Placement of Potable Point-to-point Sensors in Varying Traffic Conditions using Stochastic and Dynamic Approaches

Hyoshin Park, University of Maryland, MD, United States of America, hyoshin0724@gmail.com, Ali Haghani, Masoud Hamedi, Yashar Aliari

This work presents an application of stochastic and dynamic approaches for determining the optimal number and location of portable point-to-point sensors in freeway networks for reliable travel time prediction. Uncertainties in traffic conditions and travel time errors are considered in this work. Therefore, the resulting problem involves optimization under uncertainty. A two-stage stochastic formulation is developed. The first stage decision, which is determining the optimal number of sensors to be used, is made before the deployment. Nonlinear autoregressive neural networks are used for travel time prediction and estimated errors are obtained by integration of the data collected from existing point and point-to-point sensors providing best-fit instantaneous link travel times. The second stage evaluates the expected reduction in travel time errors for possible scenarios and specifies an optimal arrangement for sensor deployment in each scenario. Since responsiveness to too many scenarios is not realistic, a dynamic approach is also developed to accommodate limited opportunities for relocation of sensors based on the dominant traffic pattern in the freeway. The dynamic model has several predefined rearrangement stages to modify sensor locations as the traffic flow changes throughout the time horizon. Sensor acquisition and relocation expenses are also considered. Therefore, the deterministic and stochastic solutions serve as a lower bound and an upper bound for the dynamic solution, respectively. Since the decision variables are integer, branch-and-bound technique is used to solve the problem. There are meaningful differences between deterministic, stochastic, and dynamic approaches which are in turn affected by sensor costs, defined in terms of improvement in expected errors. If addition of a sensor can improve the predictions by a predefined amount, the additional sensor will be used in deployments. Higher relocation expense leads to a higher number of sensors being used, while higher sensor costs will result in deployment of fewer sensors with more frequent relocations. It is also concluded that the effect of uncertainty on sensor deployment planning is significant.

41 - SDP and SDDP Including a Linear Model of Natural Gas Network Applied to HydroThermal Planning

Andre Marcato, Associate Professor, Federal University of Juiz de Fora, Faculdade de Engenharia - PPEE, Sala 206, Juiz de Fora, MG, 36037-720, Brazil, andre.marcato@ufjf.edu.br, Paulo Alves, Ivo Silva Junior, Anderson Iung, Dejair Domingues

This paper presents a comparison between two methodologies to include the constraints related to natural gas availability in the hydrothermal systems operation planning problem. So, it will be evaluated (a) a decoupled methodology, where the optimization process determines a hydrothermal dispatch evaluating if the thermal generation targets can be met; (b) a coupled methodology, where the optimization procedure realizes the hydrothermal dispatch considering the gas availability constraints in the problem formulation. Through the results obtained it can be observed that the proposed coupled methodology presents a set of advantages when compared to the decoupled one.

42 - Estimating New HIV-infections and Analyzing Strategies for HIV-prevention

Chaitra Gopalappa, Futures Institute, 150 Pine Street, Manchester, CT, 06040, United States of America, chaitrag@gmail.com

As countries are revising their national strategies for HIV prevention it is important to know the current sources of new infections and the cost-effectiveness of intervention strategies over the long-term. We estimate new sources of HIV-infection using a probability model for which data is extracted from national surveys. We use a compartmental model to analyze the long-term impacts of scaling up treatment, considering the new WHO guidelines for treatment initiation, and basic intervention programs such as condom promotion and voluntary male circumcision that reduce risks of HIV.

43 - Game Theory Approach to Container Shipment Optimization

Qing Liu, Rahall Transportation Institute, 1900 3rd Ave., Huntington, WV, United States of America, qliu@njrati.org

Applying game theory, a set of multi-level mixed-integer nonlinear optimization models is built to study different coalitions along container import chain. Each model' optimal value represents one type of coalition's value. Each player's marginal contribution to his coalitions' values is evaluated using Shapley Value approach.

Tuesday, 1:30pm - 3:00pm

■ TC01

Level 2 - Room 200A

Quantitative Methods in Finance

Cluster: Optimization in Finance

Invited Session

Chair: Andrew Lim, Professor, National University of Singapore/U.C. Berkeley, NUS Business School, Singapore, Singapore, andrewlim@nus.edu.sg

1 - Tracking Error Models for Multiple Benchmarks

Zhichao Zheng, Assistant Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, danielzheng@smu.edu.sg, Chung Piaw Teo, Karthik Natarajan, Yunchao Xu

We propose a new multiple-benchmark tracking-error model for portfolio selection to address the agency issue. The tracking error is defined as the difference between the portfolio's return and the highest return from a set of benchmarks. We obtain the closed-form solution by linking our model to Stein's Identity. Extensive numerical tests show that our portfolio has consistent higher net Sharpe ratio and lower turnover rate than its benchmarks, in particular, the 1/n portfolio.

2 - CoCos, Bail-in, and Tail Risk

Nan Chen, Associate Professor, The Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk, Paul Glasserman, Behzad Nouri, Markus Pelger

We develop a capital structure model to analyze the incentives created by contingent convertibles (CoCos) and bail-in debt, two variants of debt that converts to equity as a bank nears or reaches financial distress. We find that CoCos generally have positive incentive effects when the conversion trigger is not set too low. A debt-induced collapse may occur when the firm takes excessive debts, changing CoCos to junior debts and reversing its incentive benefits.

3 - On The Use of Automatic Differentiation to Efficiently Determine First and Second Derivatives in Financial Instruments

Thomas Coleman, Professor and Ophelia Lazaridis University Research Chair, University of Waterloo, 200 University Ave., W, Waterloo, Canada, tfcoleman@uwaterloo.ca, xi chen

Many applications in finance require the efficient computation of the first derivatives (i.e., "Greeks") and sometimes 2nd derivatives of pricing functions of financial instruments. In this talk we illustrate how these popular pricing models exhibit structure that can be exploited, to achieve significant efficiency gains, in the application of automatic differentiation to compute 1st and 2nd derivatives of these models.

4 - Dynamic Portfolio Choice with Learning

Andrew Lim, Professor, National University of Singapore/U.C. Berkeley, NUS Business School, Singapore, Singapore, andrewlim@nus.edu.sg, Poomyos Wimonkittiwat

We present an approach for dynamic utility maximization when asset prices are modulated by a hidden Markov model with unknown transition matrix and observation statistics that combines Gibbs' sampling with approximations of the cost-to-go function in the dynamic programming. Optimality bounds are also presented.

■ TC02

Level 2 - Room 200B

Methods For Nonlinear Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Andreas Wächter, Northwestern University, IEMS Department, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, andreas.waechter@northwestern.edu

1 - Fabrication-Adaptive Optimization: Theory, Modeling, and Application to Photonic Crystal Design

Han Abby Men, Postdoctoral associate, Massachusetts Institute of Technology, 77 Mass Ave., 31-211, Cambridge, MA, 02139, United States of America, abbymen@mit.edu, Robert Freund, Ngoc-Cuong Nguyen, Joel Saa-Seoane, Jaime Peraire

Computed solutions of optimization problems often cannot be implemented directly (irrespective of data accuracy) due to technological limitations and/or deliberate simplification of a model for tractability. We present a modeling paradigm called "fabrication-adaptive optimization" that stems from the robust regularization of a function (Lewis). We develop computationally-focused theory and algorithms for the resulting non-convex problem, which we then apply to the design of photonic crystals.

2 - Reformulations of 0-norm Problems: An Empirical Study

Mingbin Feng, Ph.D. Candidate, Northwestern University, 605 Garrett PL, Apt. 260, Evanston, Il, 60201, United States of America, mingbinfeng2011@u.northwestern.edu, Andreas Waechter, Jong-Shi Pang, John Mitchell, Xin Shen

Solution sparsity is an important concern in applications such as compressed sensing and machine learning. In contrast to the common approach of 1-norm regularization, we propose a 0-norm regularization using complementarity constraints. The resulting MPCCs are solved using existing NLP software. Although the MPCC formulation has exponentially many local solutions, we present a numerical study suggesting this heuristic often finds sparser solutions than the 1-norm approach.

3 - An Active Set SQP Algorithm for Nonlinear Programming with Inexact Subproblem Solutions

Travis Johnson, PhD Candidate, Northwestern University, Engineering Science/Applied Math, 2145 Sheridan Rd., Evanston, IL, 60201, United States of America, traviscj@traviscj.com, Daniel Robinson, Andreas Waechter, Frank Curtis, Christian Kirches

We discuss theory, implementation, and integration of two algorithms: a nonlinear continuous optimization algorithm which allows reliable use of inexact subproblem solutions while also using steering rules to handle infeasible problem instances and an iterative quadratic programming solver which reuses an existing factorization of a related KKT matrix(e.g. from previous SQP iterations) to compute approximate subproblem solutions. We report extensive numerical results.

■ TC03

Level 2 - Room 200C

Multilevel Optimization

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Ted Ralphs, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, ted@lehigh.edu

1 - Bilevel Knapsack Problems: Complexity and Algorithms

Margarida Carvalho, PhD Student, Faculdade de Ciéncias da Universidade do Porto, Rua do Campo Alegre 1021/1055, Porto, 4169-007, Portugal, m@margaridacarvalho.org, Andrea Lodi, Gerhard Woeginger

There is a growing attention towards bilevel optimization due to its capability of modelling many real problems. However, this appealing side of the bilevel models comes with a cost: while integer single-level optimization problems are NP-complete, the second level of the polynomial hierarchy class is the natural hotbed for bilevel ones. In this presentation, variants of the bilevel knapsack problem will be described along with complexity results and algorithmic approaches.

2 - Multilevel and Multistage Integer Programming: Complexity and Algorithms

Ted Ralphs, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, ted@lehigh.edu, Aykut Bulut, Andrea Lodi, Gerhard Woeginger

Optimization problems with multiple levels arise in game theoretic settings in which we would like to model the decision processes of players in competition, whereas problems with multiple stages arise when a series of decisions must be made over a given time horizon, such as in stochastic programming with recourse. In this talk, we'll give a broad overview of the complexity of these problems and describe the algorithms that can be used to solve them.

3 - A Bilevel Model and Solution Approaches for a Strategic Bidding Problem in Electricity Markets

Marcia Fampa, Universidade Federal do Rio de Janeiro, PESC/COPPE, CP 68511, Rio de Janeiro, RJ, 21941-972, Brazil, fampa@cos.ufrj.br, Wagner Pimentel

A bilevel formulation for a strategic bidding problem in electricity markets is presented and solution approaches for the problem are then discussed. Numerical results are shown for case studies with configurations derived from the Brazilian electricity system.

4 - Optimal Sensor Deployment to Increase the Security of the Minimal Exposure Path

Ezgi Karabulut, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332-0205, United States of America, ezgi.karabulut@gatech.edu, Kuban Altinel, Necati Aras

Maximizing the security of maximal breach path, also known as the minimal exposure path, is an important approach in the design of WSN. This research develops a mixed integer bilevel programming formulation for the Stackelberg game between the intruder and the defender, to determine the sensor locations that maximize the exposure on the minimal exposure path. There are two basic heuristics proposed to solve this bilevel optimization problem, both employing tabu search algorithm.

■ TC04

Level 2 - Room 200D

Algorithms and Cutting Planes for Optimization under Uncertainty

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Ayse Arslan, PhD Candidate, University of Florida, Gainesville, FL, 32608, United States of America, nur.arslan@ufl.edu

1 - A Decomposition Algorithm for a Chance-constrained Program with Recourse

Xiao Liu, Ohio State University, 1971 Neil Ave., Columbus, OH, United States of America, liu.2738@buckeyemail.osu.edu, Simge Küçükyavuz

We consider a class of two-stage stochastic optimization problems. In the first stage, a set of decisions must be made before random parameters, with finite support, are revealed. In the second stage, after the realization of uncertain parameters, recourse decisions are made at an additional cost such that a certain service level is met with high probability. We propose a finite decomposition algorithm for this class of problems, and report our computational experiments with it.

2 - An Optimal Edge Search for a Stationary Hider with Imperfect Detection Information

Shantih Spanton, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, sspanton@ufl.edu, Joseph Geunes, J. Cole Smith

We consider a searcher who seeks an immobile hider on an undirected network. The searcher may only traverse a finite number of edges along the search path. With each traversal of a network edge, the likelihood of discovering the hider upon that edge is reduced. A search path that maximizes the probability of discovering the hider is found.

3 - An Efficient Benders Decomposition Algorithm for Chance-constraint MIP

Yu An, University of South Florida, 4202 E Fowler Ave., ENB 118, Tampa, FL, 33620, United States of America, yan2@mail.usf.edu, Bo Zeng, Ludwig Kuznia

Chance-constrained stochastic program with a finite support is often formulated using big-M method, which makes it computationally challenging. We adopt Benders decomposition strategy to develop our algorithm that does not assume a large big-M. Various improvement methods of Benders are also applied to achieve better performance. Numerical results will be presented.

■ TC05

Level 2 - Room 200E

Stochastic Integer Programming Methods and Applications

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Lewis Ntaimo, Associate Professor, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX, 77843, United States of America, ntaimo@tamu.edu

1 - Integrated Warehouse-Inventory-Transportation Planning under Uncertainty

Nan Kong, Assistant Professor, Purdue University, Evanston, IN, United States of America, nkong@purdue.edu, Christopher Hagmann, Pratik Parikh

Warehouses play a vital role in mitigating variations in supply and demand and in providing value-added services in a supply chain. However, warehousing decisions are often not incorporated when developing distribution plans in practice. We develop a two-stage stochastic integer quadratically-constrained program for the problem of integrated warehouse-inventory-transportation planning under uncertainty. We apply a scenario decomposition approach and report preliminary computational findings.

2 - Fenchel Decomposition for Stochastic Integer Programs with Special Structure

Saravanan Venkatachalam, PhD Candidate, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX, United States of America, saravanan@entc.tamu.edu, Eric Beier, Luca Corolli, Lewis Ntaimo

We implement and perform a computational study of a Fenchel decomposition algorithm for two stage stochastic 0-1 integer programs with special structure. The algorithm involves generating Fenchel cuts in a scenario-wise decomposition setting and techniques for upper bounding for faster convergence of the algorithm. Computational results using large scale test instances will be presented.

3 - Preprocessing Stochastic Integer Programs with Stochastic Decomposition

Suvrajeet Sen, Professor, University of Southern California, Daniel J. Epstein Department of ISE, Los Angeles, CA, 90089, United States of America, S.sen@USC.edu, Yifan Liu

Stochastic Decomposition (SD) provides a relatively stable platform for solving stochastic linear programs with both discrete and continuous random variables. We report the performance of such a preprocessing step for decomposition-based branch-and-cut algorithms such as D2BAC.

4 - Branch-and-Cut for Probabilistically Constrained Stochastic Integer Programs

Julian Gallego, Texas A&M University, Austin, TX, United States of America, kamizama77@tamu.edu, Lewis Ntaimo

Probabilistically constrained stochastic integer programs (SIP-C) are challenging since its feasible region is generally non-convex. In addition, very weak lower (upper) bounds on the objective function are obtained from the linear relaxation to deterministic equivalent reformulations of SIP-C. We present a new branch-and-cut method for SIP-C with random technology and right-hand side based on irreducible infeasible subsystems (IIS). We report computational results based on standard instances.

■ TC06

Level 2 - Room 200F

Social Network Analysis I

Sponsor: Optimization/Networks

Sponsored Session

Chair: Alexander Nikolaev, Assistant Professor, University at Buffalo (SUNY), 312 Bell Hall, Buffalo, NY, 14260-2050, United States of America, anikolae@buffalo.edu

1 - Modeling the Emergence of Leadership Reliance Networks

Sophia Sullivan, Research Assistant, Northwestern University, 1578 Oak Ave., Apt. 1, Evanston, IL, 60201, United States of America, sophiasull@gmail.com, Leslie DeChurch, Noshir Contractor

There has been recent interest in understanding the emergence of leadership in organizations from a network perspective. This study will present a computational model for the emergence of leadership reliance ties and empirically validates the model using data from experiments conducted on multi-team systems.

2 - The Formation and Evolution of Teams in New Scientific Fields: A Hybrid Model Approach

Alina Lungeanu, Northwestern University, 2240 Campus Drive, Evanston, IL, 60208, United States of America, alina.lungeanu@u.northwestern.edu, Sophia D. Sullivan, Noshir Contractor

This paper examines the formation and evolution of teams in new scientific fields. We propose five mechanisms that affect the likelihood of co-authorship in a scientific team. We model the effects of these mechanisms by developing a hybrid simulation model and we compare its results with statistics from the observed longitudinal co-authorship network. This paper presents a first application of hybrid models in research examining the evolution of new scientific fields via the emergence of teams.

3 - A Team Formation Problem Based on Social Structure Measures

Alireza Farasat, PhD Student, University at Buffalo, Department of Industrial and Systems Eng, 327 Bell Hall, Amherst, NY, 14260, United States of America, afarasat@buffalo.edu, Alexander Nikolaev

This paper presents a mathematical approach to a Team Formation Problem (TFP) with a pool of individuals embedded into a network. Network structure in the resulting teams is assumed to influence team performance. The problem is proven NP-Hard, and its IP formulation is provided. An algorithm employing the variable depth neighborhood Lin-Kernighan idea is presented to tackle TFP on large networks.

■ TC07

Level 2 - Room 200G

Analysis and Optimization of Stochastic Systems via Robust Optimization

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Velibor Misic, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40, Cambridge, MA, 02139, United States of America, vvmisic@mit.edu

1 - The Power of Flexibility in Dynamic Scheduling: A Case Study

Chaithanya Bandi, Massachusetts Institute of Technology, Cambridge, MA, United States of America, cbandi@mit.edu

We consider a multi-resource allocation problem with multiple classes of jobs in a dynamic environment being served by two types of servers, experts and non-experts. The jobs have hard deadlines and arrive randomly but with known seasonality patterns. In this paper, we consider the problem of designing these systems both at the strategic structure level as well as at a tactical level. We demonstrate that by just a little flexibility leads to huge gains in managing load imbalance and efficiency.

2 - Robust and Sample Path Optimization of Manufacturing Systems

Mike Veatch, Professor, Gordon College, Department of Mathematics, 255 Grapevine Rd., Wenham, MA, 01984, United States of America, mike.veatch@gordon.edu

We consider performance and optimization of manufacturing lines with machine failures and finite buffers. Mixed integer programs are used to compute makespan and sojourn times. Interarrival and service times are either simulated once (sample path optimization) or their sums are constrained in a robust optimization.

3 - A Comparison of Robust Optimization and Monte Carlo Tree Search for Dynamic Resource Allocation

Velibor Misic, PhD Student, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40, Cambridge, MA, 02139, United States of America, vvmisic@mit.edu, Dimitris Bertsimas, J. Daniel Griffith, Vishal Gupta, Mykel Kochenderfer

We consider a stylized wildland fire control problem where one must dynamically deploy resources to suppress the fire and minimize cumulative damage. We apply two solution approaches to this high-dimensional Markov decision process (MDP): Monte Carlo tree search and robust optimization. Computational experiments show that the two methods obtain high quality solutions in operationally feasible computational times.

■ TC08

Level 2 - Room 200H

Constraint Programming II

Sponsor: Computing Society

Sponsored Session

Chair: Willem-Jan van Hoeve, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, vanhoeve@andrew.cmu.edu

1 - Roadblocks to the Efficient Parallelization of Constraint Solvers
Horst Samulowitz, Research Scientist, IBM Research, 1101 Kitchawan Rd., Yorktown Heights, NY, 10598, United States of America, samulowitz@us.ibm.com, Ashish Sabharwal, George Katsirelos, Laurent Simon

While modern day hardware provides access to 10,000 and more compute cores, so far parallel versions of combinatorial search algorithms are unable to effectively exploit more than 20 or so cores. This talk aims to raise awareness of the fact that the mechanisms underlying such sequential algorithms can sometimes impose major bottlenecks to their efficient parallelization.We provide a novel look into the behavior of the founding principles of sequential SAT solvers in a parallel setting.

2 - Finite-domain Cuts for the Linear Arrangement Problem
John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, jh38@andrew.cmu.edu, Cid de Souza, Alexandre Freire

Integer programming models provide no useful polyhedral bounds for the linear arrangement problem and the closely related minimum bandwidth problem, due to the difficulty of giving the problem a 0-1 formulation. We therefore propose a constraint-programming style finite-domain model of the problem in which the variables are edge labels. We study the associated polyhedron and investigate experimentally some bounds based on cuts derived from this polyhedron.

3 - Degree Constrained Minimum Spanning Tree: A Hybrid Approach using Linear Programming Relaxations
Louis-Martin Rousseau, CIRRELT - Polytechnique Montréal, CP 6079 Succ Centre-Ville, Montréal, Se, H3C 3A7, Canada, louis-martin.rousseau@cirrelt.net, Xavier Lorca, Jean-Guillaume Fages

This paper presents a Constraint Programming approach for solving the Degree Constrained Minimum Spanning Tree Problem. It is based on relaxations techniques stemming from Operations Research, such as Lagrangian and Linear relaxations. The contribution of this paper is a fine integration of these techniques within a Constraint Programming framework. The experiments show that our approach outperforms the state-of-the-art dedicated method of Salles Da Cunha and Lucena on a class of instances.

■ TC09

Level 2 - Room 200I

Risk-Averse Decision Models

Sponsor: Analytics Section

Sponsored Session

Chair: Andrzej Ruszczynski, Rutgers University, Department of Management Science, 94 Rockafellar Road, Piscataway, NJ, 08854, United States of America, rusz@business.rutgers.edu

1 - Risk-averse Control of Markov Models
Andrzej Ruszczynski, Rutgers University, Department of Management Science, 94 Rockafellar Road, Piscataway, NJ, 08854, United States of America, rusz@business.rutgers.edu, Ozlem Cavus

Risk-averse control problems for discrete-time controlled Markov models are considered. The objective functional is a Markov dynamic risk measure of the total cost. Dynamic programming equations are derived. Two solution methods, value and policy iteration, are discussed. In the policy iteration method we propose two algorithms for policy evaluation: nonsmooth Newton's method and convex programming. The results are illustrated on several examples.

2 - Time-consistent Approximations of Risk-averse Multistage Stochastic Optimization Problems
Tsvetan Asamov, Rutgers University, 640 Bartholomew Rd., Piscataway, NJ, 08854, United States of America, tsvetan.asamov@gmail.com, Andrzej Ruszczynski

We use dynamic time-consistent formulations to approximate problems having a single coherent risk measure applied to the aggregated costs over all time periods. The dual representation of coherent risk measures is used to create a time-consistent cutting plane algorithm. Additionally, we also develop methods for the construction of universal time-consistent upper bounds. Our numerical results indicate that the resulting dynamic formulations yield close approximations to the original problem.

3 - Two-stage Portfolio Optimization with Higher-order Conditional Measures of Risk
Sitki Gulten, PhD Candidate, Rutgers University, Management Science & Inf. Systems, 1 Washington Park, Newark, NJ, 07102, United States of America, sgulten@business.rutgers.edu, Andrzej Ruszczynski

We describe a study of novel risk modeling and optimization techniques to daily portfolio management. First, we develop and compare specialized methods for scenario generation and scenario tree construction. Second, we construct a two-stage stochastic programming problem with conditional measures of risk, which is used to re-balance the portfolio on a rolling horizon basis, transaction costs included in the model. Third, we present an extensive simulation study on real-world data.

4 - Probabilistic Constrained Problems with Compound Distributions
Anh Ninh, Rutgers University, 640 Bartholomew Road, Piscataway, NJ, 08854, United States of America, anhninh@rci.rutgers.edu, Andras Prekopa

We prove that the compound Poisson distribution is log-concave, under some conditions for the distribution of the terms. Then we formulate and solve probabilistic constrained stochastic programming problems, for both the discrete and continuous distribution cases, regarding the compound random variables. Applications in insurance and finance will be mentioned.

■ TC10

Level 2 - Room 200J

Creative Techniques for OR/MS Education

Sponsor: INFORM-ED

Sponsored Session

Chair: James Cochran, Louisiana Tech University, Ruston, LA, United States of America, jcochran@latech.edu

1 - Bringing Business Analytics to Your Desktop
Kala Seal, Professor, Loyola Marymount University, One LMU Drive, Los Angeles, CA, 90045, United States of America, Kala.Seal@lmu.edu, Zbigniew Przasnyski

We propose a Business Analytics (BA) architecture that can be implemented on a desktop using free or readily available software. We show how the architecture can allow users to develop understanding of data management issues, OLAP concepts, Data Mining and Visual Analytics without imposing a steep learning curve. The architecture uses MySQL for the back end database, Excel, PowerPivot and MS-Access for data access and OLAP, and XLMiner and Tableau for data mining and visualization.

2 - Poet: An Online Education Tool for Overcoming Student Difficulties with Optimization Modeling
Sung-Hee Kim, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, kim731@purdue.edu, Rachael H. Kenney, Nelson Uhan, Jikai Zou, Ji Soo Yi

POET (Purdue Optimization model Education Tool) is a web-based visual interactive tool to help students form optimization models from word problems. We assessed its effectiveness with 79 engineering students in an undergraduate optimization course. Our pre- and post-test results show that POET did not drastically improve students' modeling skills, but did help them avoid particular types of errors. We will present how instructors can use POET as a supplementary tool in an optimization class.

3 - Business Analytics in the Liberal Arts
Avijit Sarkar, Associate Professor, University of Redlands, 1200 E. Colton Avenue, Redlands, CA, 92373, United States of America, avijit_sarkar@redlands.edu, Hindupur Ramakrishna

Due to the big data and analytics revolution, business analytics programs and coursework are evolving in many B-schools. This research contains an illustration of a business analytics course in a graduate program for management professionals in a B-School situated in a liberal arts university. We examine what analytics means in a liberal arts context and discuss challenges due to the accelerated nature of the course. An innovative aspect of the course is an introduction to location analytics.

4 - Connecting the Students to the World
Michael Racer, University of Memphis, Memphis, TN, United States of America, mracer@memphis.edu

"This material was hard" - how often do we hear that phrase from students unfamiliar with statistics and operations research techniques. In this talk, we will discuss the approach we take in a two course sequence in the business school. The goal is to make the students comfortable with using the tools were teaching. And at the same time convince them that there are real applications real world

5 - Mary Worth (or Calvin and Hobbes or Charlie Brown or Opus...) Teaches Operations Research

James Cochran, Louisiana Tech University, Ruston, LA, United States of America, jcochran@latech.edu, Aadel Darrat

We report on the use of scripting in an introductory statistics course. We obtained a series of related color panels featuring two characters of the Mary Worth comic strip. We then removed all dialogue, thoughts, and narration, and instructed students to write dialogue, thoughts, and narration so that one character explained a concept (trimmed mean or covariance). Results from an experiment utilizing a completely randomized design are discussed, and examples of student efforts are presented.

■ TC11

Level 2 - Room 201A

Panel Session With the Clinton Health Access Initiative

Sponsor: Minority Issues

Sponsored Session

Chair: Julie Ivy, Associate Professor, North Carolina State University, Edward P. Fitts Department of Industrial, 400 Daniels Hall, Raleigh, NC, 27695-7906, United States of America, jsivy@ncsu.edu

1 - Improving Global Healthcare Delivery through Robust Analytical Methods

Moderator: Jennifer Campbell, Clinton Health Access Initiative, United States of America, jcampbell@clintonhealthaccess.org, Panelists: Elizabeth McCarthy, Paul Domanico

Clinton Health Access Initiative (CHAI) will introduce their work on global health issues related to evidence-based research and operations research. Members of the CHAI Applied Analytics Team will discuss their use of OR methods for improving healthcare delivery in resource limited settings.

■ TC12

Level 2 - Room 201B

Undergraduate OR Prize Finalists

Cluster: INFORMS Undergraduate Operations Research Prize

Invited Session

Chair: Vincent Slaugh, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15208, United States of America, vslaugh@cmu.edu

1 - Undergraduate OR Prize Finalists

INFORMS Undergraduate OR Prize finalists will present their research.

2 - The Search of Experimental Design with Tens of Variables

Yaileen M. Mendez-Vazquez, University of Puerto Rico at Mayaguez, Puerto Rico, yaileen.mendez@upr.edu, Kasandra L. Ramires-Rojas

Abstract not Available

3 - Quantitative Models of Healthcare Finance: Decision Tree Analysis

Rebecca Swaszek, Lehigh University, PA, United States of America, rswaszek@gmail.com

Abstract not Available

4 - Flight Scheduling Optimization for AnadoluJet/Turkish Airlines

Cagil Kocyigit, Bilkent University, Ankara, Turkey, Isil Koyuncu, Melis Beren Ozer, Tunca Turkoglu, Basak Kepir, Nazli Busra Akar

Abstract not Available

5 - Designing a Simulation Tool for Commercial Cross-Docking Application

Samuel Lim, University of Pennsylvania, PA, United States of America, samuelim@seas.upenn.edu, Frederick Abiprabowo, Napat Harinsuit, Willis Zhang

Abstract not Available

■ TC13

Level 2 - Room 202A

New Product Development II: Testing, Adoption, and Optimization

Contributed Session

Chair: Hongyi Chen, University of Minnesota Duluth, 1305 Ordean Ct, 105 VKH, Duluth, MN, 55812, United States of America, honchen@d.umn.edu

1 - Wireless Wearable System for Monitoring of Sleep Apnea and Other Cardiorespiratory Disorders

Woranat Wongdhamma, Oklahoma State University, 322 Engineering North, Oklahoma State University, Stillwater, OK, 74078, United States of America, woranat@okstate.edu, Satish Bukkapatnam, Trung Le

This paper reports the development of a wireless, wearable, multi-sensor suite for diagnosis cardiorespiratory disorders with a particular focus on sleep apnea screening. The suite is designed to synchronously gather 3-lead VCG signals, heart sound signals, digitized oxygen saturation signals, and respiratory signals. The signals are transmitted to a processing and visual graphic unit via a Bluetooth module. The system can serve as an out-of-center Type III sleep apnea screening device.

2 - Multi-stage Testing in New Product Development (NPD)

Fang Cui, School of Management, Xi'an Jiaotong University, PO Box 1850, Xi'an Jiaotong University, Xi'an, China, 15091054888@139.com, Wentian Cui, Jun Lin

Testing is essential and multi-stage design mode is popular in NPD. Previous studies often ignore two typical features of multi-stage design process (MDP). This paper presents an analytical model for scheduling of tests in MDP. We derive optimal stopping rules for each stage' testing and the impact of different model parameters, such as redesign cost, the reliability between upstream and downstream, problem-solving capacity, opportunity cost, and the level of quality on the optimal solution.

3 - Optimizing the Technology Development Paths by Incorporating the Switching Costs into the TDE Model

Hongyi Chen, University of Minnesota Duluth, 1305 Ordean Ct, 105 VKH, Duluth, MN, 55812, United States of America, honchen@d.umn.edu, Kyle Turner

Technology Development Envelope (TDE) helps companies identify technology development paths containing technologies that rank the highest in each concerned time period based on experts' judgment and technology forecast. As this approach does not consider the cost involved when the R&D and manufacturing switch from the current technology to another highly ranked technology, an optimization model is proposed to generate optimal development path(s) by including manufacturing and switching cost.

4 - Managerial Decision Support Tool – R Package for Technology Forecasting & Product Evaluation

Tom Shott, Portland State University, Portland, OR, 97214, United States of America, tom.n.pdx@gmail.com, Tim Anderson, Dong-Joon Lim

TFDEA (Technology Forecasting using Data Envelopment Analysis) analyzes and forecast technology trends based on a product's key performance attributes. A recently released R package makes this emerging methodology broadly accessible. This talk focuses on using the approach to provide additional management insight from independent data driven analysis. It demonstrates using the software for forecasting technology and industry trends, new product planning and project risk evaluation.

■ TC14

Level 2 - Room 202B

Acta Automatica Sinica - Parallel Control and Management

Cluster: International Activities Committee

Invited Session

Chair: Fei-Yue Wang, feiyue@gmail.com

Co-Chair: Lefei Li, Tsinghua University, Room 608, Shunde Building, Beijing, China, lilefei@tsinghua.edu.cn

1 - Parallel Service Management: Better Understanding, Better Life
Lefei Li, Tsinghua University, Room 608, Shunde Building, Beijing, China, lilefei@tsinghua.edu.cn

We always say: the customer is god. However, do we really understand this 'god'? In practice, the nature of service, such as intangibility and heterogeneity, make the effective management of service operations difficult. To better incorporate human behaviors and other complex factors to facilitate service management decisions, we propose a new approach, Parallel Service Management (PSM), which follows the ACP framework,a emerging methodology in complex systems modeling and analysis. In PSM, customer agents, service employee agents, service organization agents and service environment construct an artificial service system, which can run in parallel with the real service system. In this way, the artificial system can learn from the real system dynamically. By doing vast computational experiments, we are able to feedback good decision suggestions to the real system, and therefore providing a better service to the customers.

2 - On Computational Experiment in the Parallel Public Transportation System
Runmei Li, Beijing Jiaotong University, Beijing, China, rmli@bjtu.edu.cn, JiangZhong Liu, Fenghua Zhu

The problem of how to carry out the computational experiments in the parallel public transportation system is studied. The computational experiments is done by the following three steps: determining the initial departure time of the buses; adjusting the initial departure time in a small interval in order to get some experiment plans, and then, applying these adjusted departure times to the parallel public transportation system and choosing the suitable departure time.

3 - Recommendation System in E-commerce Based on ACP Approach
Chen Lu, Tsinghua University, 610A, Zijing 12#, Tsinghua University, Beijing, China, shenlanghuhu@163.com, Lefei Li

Traditional recommendation methods, such as collaborative filtering, are based on historical data, and can hardly describe consumer behaviors accurately. In our study, we introduce an online recommendation system based on ACP approach to intelligently forecast products of customers' interest and provide customized recommendations. Our method has the unique advantages that it can keep track of users' property and preference changes, and provide timely response to events and environment changes.

■ TC15

Level 2 - Room 203

Best Paper Award - Competitive Presentations II, Service Science Section

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, Distinguished Professor, National Taiwan University, 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan - ROC, mhhuang.ntu@gmail.com

1 - Market Segmentation of Call Centers: The Case for Back-sourcing
Yu Xia, Associate Professor, Northeastern University, 214 Hayden Hall, 360 Huntington Ave., Boston, MA, 02115, United States of America, y.xia@neu.edu, Bintong Chen, Vaidy Jayaraman, Charles Munson

We construct a theoretical model to study call centers with different wage rates and productivity levels that compete for contracts of multiple clients. We develop conditions for a call center to dominate the market and conditions for several call centers to coexist in the market. These results are then used to explain the back-sourcing phenomenon in the market. We survey an international service provider and find a strong match between our theoretical results and the empirical evidence.

2 - A Service Classification Framework based on Joint Production
Guillaume Roels, UCLA, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, guillaume.roels@anderson.ucla.edu

This paper analyzes the economics of joint production in services between a customer and a service provider. We study how efforts change when they become more complementary and when their distribution shifts from one party to the other. Our analysis give rise to a product-process matrix for services with three extreme working modes: independent processing by the provider, independent processing by the customer, and direct interaction.

3 - Servitization: Disentangling the Impact of Service Business Model Innovation on Manufacturing Firm Products
Ivanka Visnjic, Professor, ESADE Business School, Spain, ivanka.visnjic@gmail.com, Bart Van Looy

As manufacturing businesses operate in an ever more competitive, global economy where products are easily commoditized, innovating by adding services to the core product offering has become a popular strategy. Contrary to the economic benefits expected, recent findings pinpoint implementation hurdles that lead to a potential performance decline, the so-called "servitization paradox'.

4 - Formulating and Solving Call Center Scheduling Models in Excel
Thomas Robbins, Assistant Professor, East Carolina University, 3212 Bate Building, Greenville, NC, 27858, United States of America, robbinst@ecu.edu

Call center scheduling models present a significant challenge to operations researchers and practitioners alike. Though conceptually simple to describe, straightforward scheduling options create a combinatorial explosion that makes model difficult to solve to optimality. We examine the drivers of complexity and investigate the feasibility of solving these models in Excel. We present two different formulations; a standard set-covering model and a more complex global constraint model.

■ TC16

Level 2 - Room 204

Health Care Operations Management

Sponsor: Health Applications

Sponsored Session

Chair: Retsef Levi, Massachusetts Institute of Technology, 100 Main St., E62-562, Cambridge, MA, 02142, United States of America, retsef@mit.edu

1 - Capacity Planning and Participant Scheduling in Clinical Research Units
Jivan Deglise-Hawkinson, University of Michigan, Ann Arbor, MI, United States of America, jivan@umich.edu, Mark Van Oyen, Blake Roessler

Clinical trial protocols demand complex coordination of physical and human resources over time for each participant. A clinical research unit site must service many trials. We develop a novel stochastic planning model that uses forecasting and optimization to control participant mix, access and staff overtime. We also recursively optimize and update the daily participant booking reservation strategy and the daily staffing coordination plan to transition from planning to real time scheduling.

2 - Optimizing the Timing of Prophylactic Antibiotics
Bryan Norman, banorman@pitt.edu, Bruce Lee, Sarah Bartsch, Matheus Balceiro Rodriques

Surgical site infections are common postoperative complications that affect patient quality of life and increase health care costs. One strategy that can be highly effective in reducing the incidence of surgical site infections is providing prophylactic antibiotics to patients prior to surgical incision. In this analysis we evaluate the effects of administering prophylactic antibiotics during different presurgical activities to determine a time that minimizes surgical site infections.

3 - Monthly Scheduling of Residents at Internal Medicine Clinics
Zhichao Shu, The University of Texas at Austin, 3500 Greystone Drive, Apt. 223, Austin, TX, 78731, United States of America, shuzhichao@gmail.com, Jonathan Bard, Luci Leykum

This paper presents a new model for constructing monthly clinic schedules for interns and residents training in Internal Medicine. The problem is formulated as an integer goal program and a three-phase methodology is proposed to find solutions. After pre-processing, a commercial solver is used to obtain tentative solutions and then improvements are made in the post-processing step. The effectiveness of the methodology is demonstrated by analyzing real data.

4 - On the Access-throughput Spiral Effects in Large Academic Centers
Cecilia Zenteno, Postdoctoral Fellow, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E62-389, Cambrdige, MA, 02139, United States of America, ceciliaz@mit.edu, Peter Dunn, Ulrich Schmidt, Retsef Levi, Tim Carnes, Benjamin Christensen, Bethany Daily

We demonstrate empirically and statistically the surprisingly adverse impact of patient flow disruptions from ICU to regular bed floors in large academic hospitals. We call this the Access-Throughput Spiral Affect.

■ TC17

Level 2 - Room 205A

IT-Service

Sponsor: Service Science

Sponsored Session

Chair: Abhishek Kathuria, Assistant Professor, University of Hong Kong, Pokfulam, Hong Kong, Hong Kong - PRC, kathuria@hku.hk

1 - Upgrading Policy after the Redesign of a Component for Reliability Improvement
Geert-Jan van Houtum, Eindhoven University of Technology, PO Box 513, Eindhoven, 5600MB, Netherlands, g.j.v.houtum@tue.nl, Kurtulus Oner, Gudrun Kiesmuller

Consider an installed base of technical systems maintained by one party, which has to meet a given target system availability level. For a given component, a more reliable version has been designed. Should one immediately replace the current components in the systems by new components, or should one do this gradually, e.g., after failures of the current components? We will study multiple upgrading policies and showing their effect on system availability, downtime costs and maintenance costs.

2 - Service Systems with Finite and Heterogeneous Customer Arrivals
Rowan Wang, University of Minnesota, 111 Church St., SE, Minneapolis, MN, 55455, United States of America, wang1075@umn.edu, Oualid Jouini, Saif Benjaafar

We consider service systems with a finite number of customer arrivals, where customer inter-arrival times and service times are both stochastic and heterogeneous. We obtain various performance measures of interest including waiting time and makespan. We carry out extensive numerical experiments to examine the effect of heterogeneity in inter-arrival and service times. We derive several managerial insights and discuss implications for settings where such features can be induced.

3 - Temperament, Character, and Customer Loyalty
Han-Chung Huang, PhD Candidate, Chang Gung University, 259, Wenhua 1st Rd., Gueishan, Taoyuan, 333, Taiwan - ROC, t756068@yahoo.com.tw;, Ching-I Teng

Previous studies have started to focus on the link between customer personality and loyalty. Psychological theories are used for developing hypotheses. This study examines how the seven dimensions of Temperament and Character dimensions are related to customer loyalty in an online context. Mixed findings are observed regarding the correlations between the seven dimensions and customer loyalty. Implications of the study findings are discussed.

■ TC18

Level 2 - Room 205B

Service Applications

Sponsor: Service Science

Sponsored Session

Chair: Sandjai Bhulai, VU University Amsterdam, Faculty of Sciences, De Boelelaan 1081a, Amsterdam, 1081HV, Netherlands, s.bhulai@vu.nl

1 - Prediction Aided Bed Management Decision Support System
Bex Thomas, Researcher, GE Global Research, 1 Research Circle, Niskayuna, NY, 12019, United States of America, thomasb@ge.com

Bed management is an important function of any hospital with a major impact on patient care, patient flow and ultimately the hospital operating margin. We demonstrate the use of simulation based capacity prediction models to proactively manage bed assignments.

2 - Sustainable Health Care Supply Chains
Cigdem Gurgur, Indiana University, Purdue University Fort Wayne, Fort Wayne, IN, United States of America, gurgurc@ipfw.edu

Recent years have witnessed a profound interest in healthcare waste given its impact on costs and the environment. In this study we consider a hybrid simulation model that incorporates both productivity and sustainability related criteria in helping capacity management decisions.

3 - Service-Level Distribution of Multi-Server Queues
Sandjai Bhulai, VU University Amsterdam, Faculty of Sciences, De Boelelaan 1081a, Amsterdam, 1081HV, Netherlands, s.bhulai@vu.nl, Alex Roubos, Rene Bekker

Many service levels are expressed as fractions of customers who are waiting at most some threshold value. A steady-state analysis provides the long-run average service level, but neglects the variations on shorter time scales. In this paper we obtain the distribution of the service level after a finite time. We study a time-average equivalent using Levy processes. We illustrate these results by applying the techniques to a call routing problem in a multi-site call center setting.

■ TC19

Level 2 - Room 205C

Network Science and Random Graphs

Sponsor: Applied Probability

Sponsored Session

Chair: John Hasenbein, Graduate Program in ORIE, The University of Texas at Austin, Austin, TX, 78712, United States of America, jhas@mail.utexas.edu

1 - Directed Random Graphs with Given Degree Distributions
Ningyuan Chen, PhD Candidate, Columbia University, 321 S. W. Mudd Building, 500 W. 120th Street, New York, NY, 10027, United States of America, nc2462@columbia.edu, Mariana Olvera-Cravioto

We propose an algorithm to generate directed random graphs with prescribed degree distributions F and G. By the algorithm the in- and out-degree sequences we draw converge to i.i.d. random variables of F and G as the number of nodes grows to infinity, though the equal sum restriction is imposed. We show that by repeatedly generating the graph or erasing self-loops and extra multiple edges, the procedure results in a simple graph without significantly affecting the degree distributions.

2 - Large Graph Limits for Configurational Constructions of Random Networks - Applications to SIR Epidemy
Pascal Moyal, Université de Technologie de Compiègne, Rue Roger Couttolenc, CS 60319, Compiègne, 60203, France, pascal.moyal@utc.fr

We present two constructions of random networks inspired by the configuration model: the course of a SIR epidemy on a human population, and the processing of a CSMA algortithm on a set of interacting nodes. In both cases, we construct, and represent the population by partially constructed random graphs, described in turn by point measure-valued processes. We then obtain fluid limits for these processes under large graph limit.

3 - Giant Component in Random Multipartite Graphs with Given Degree Sequences
Sidhant Misra, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 32D-572, Cambridge, MA, 02139, United States of America, sidhant@MIT.EDU, David Gamarnik

We consider a random multipartite graph with p parts generated according to a given degree sequence. Vertices have vector degrees and each component of this vector is the number of neighbors of the vertex in the corresponding part of the graph. We assume that the degree sequence converges to a probability distribution. Under certain mild regularity assumptions, we characterize the conditions under which, with high probability, there exists a giant component.

4 - Detecting Viruses in Large Contact Networks
John Hasenbein, Graduate Program in ORIE, The University of Texas at Austin, Austin, TX, 78712, United States of America, jhas@mail.utexas.edu, David Morton, Jinho Lee

We consider the problem of detecting a virus propagating through a contact network. We are interested in large social networks graphs with millions of nodes. The objective is to place a constrained number honeypots at a subset of nodes in order to either minimize the expected time until detection or maximize the probability of detection by a certain time. To obtain realistic problem instances we mined a database containing sampled call data from one of Asia's largest service providers.

■ TC20

Level 2 - Room 205D

Learning and Consumer Behavior in Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Victor Araman, American University of Beirut, Beirut, Lebanon, va03@aub.edu.lb

1 - Dynamic Pricing of Low-priority Users in Wireless Networks

Arnoud den Boer, Eindhoven University of Technology, PO Box 513, 5600 MB, Eindhoven, Netherlands, a.v.d.boer@tue.nl

In cognitive radio networks, primary users (PUs) are licensed to use spectrum capacity. These PUs are not continuously using their capacity. Since sectrum capacity is scarce, operators allow secondary users (SUs) to use spectrum whenever PUs are absent. However, if the PU returns when a SU is present, costs are encountered due to the PU's service degradation. We study dynamic pricing for SU channel access, where the price dynamically varies with the expected time that the PU remains absent.

2 - Dynamic Pricing with Time-varying Valuations

Victor Araman, American University of Beirut, Beirut, Lebanon, va03@aub.edu.lb

We consider consumers interested in buying a non perishable product. A number of these consumers arrive each period, each with an initial valuation that will be varying with time governed by a Markov chain. Consumers can buy the product and leave the "system" at anytime if the price at this time is below their valuation. Moreover, any consumer in the system might at some point stop being interested in the product and also leave. We look at finding the optimal pricing strategy that will maximize the long run average revenue function.

3 - Product Upgrade Strategies: Is Technology a Threat or a Competitive Opportunity?

Sam Kirshner, Queen's University, 143 Union Street, Kingston, ON, Canada, skirshner@business.queensu.ca

Product upgrade strategies have a significant impact on a firm's profits, particularly in industries characterized by high R&D investment costs and an evolving technological frontier. To understand the impact of competitive pressures, we model the optimal size and timing of a firm's upgrade when consumers are influenced by the latest innovation. The model is used to analyze whether technology is an opportunity, helping to increase profits, or a threat, which forces the firm out of the market.

■ TC21

Level 2 - Room 206

Disease Models and Economic Evaluation

Sponsor: Health Applications

Sponsored Session

Chair: Greg Zaric, Ivey Business School, 1151 Richmond St., London, ON, Canada, gzaric@ivey.uwo.ca

1 - Screening and Diagnosis of Tuberculosis in Prisons in Russia and Eastern Europe

Diana Negoescu, Stanford University, negoescu@stanford.edu, Douglas Owens, Daniel Winetsky, Emilia DeMarchis, Jeremy Goldhaber-Fiebert

Prisons of the former Soviet Union have high rates of multidrug-resistant tuberculosis (TB) and are thought to drive general population TB epidemics. Effective prison case detection, through employing more expensive technologies, may reduce long-term treatment costs and slow transmission. We develop a dynamic transmission model of TB matched to the epidemiology and costs in prisons, and we evaluate the cost-effectiveness of eight strategies for TB screening and diagnosis.

2 - Eliciting Cholesterol Management Guidelines' Valuation of Future Life

Murat Kurt, Assistant Professor, University at Buffalo, SUNY, North Campus, 309 Bell Hall, Buffalo, NY, 14260, United States of America, muratkur@buffalo.edu, Osman Ozaltin, Brian Denton, Nilay Shah

Lipid abnormalities increase the risk of heart attack and stroke. The complexity of treating these abnormalities led to the development of treatment guidelines. We consider the trade-off between the benefits and side effects of statins, and develop an inverse stochastic dynamic program to elicit time valuation of current guidelines. We use clinical data to illustrate the outcomes on Type 2 diabetes patients.

3 - Optimal Resource Allocation for Multi-level Preventive Care for Type 2 Diabetes

Karca Aral, PhD Candidate, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, karca.aral@insead.edu, Stephen E. Chick, Alfons Grabosch

We propose a mathematical model for T2 Diabetes that comprehends the interactions of multiple interventions including primary, secondary, and tertiary prevention. We use the model to design an optimal preventive care policy. We compare the model outcomes with real-life recommendations, and provide insights on multi-level chronic disease prevention.

4 - Economic Evaluation of Tests to Determine the Source in Cancer of Unknown Primary

Greg Zaric, Ivey Business School, 1151 Richmond St., London, ON, Canada, gzaric@ivey.uwo.ca, Salah Mahmud, George Rodrigues, Peter Rogan, Malek Hannouf, Chong Kim, Sisira Sarma, Eric Winquist, Muriel Brackstone, Jeffrey Hoch

Metastatic cancer of unknown primary origin (CUP) represents 3-5% of all new cancer cases. Recently, several tests have been developed to help identify the primary when conventional methods have failed. One particular test costs $4500 and has 70-90% accuracy in identifying the source in CUP. We develop a decision-analytic model to investigate the cost effectiveness of this test and parameterize the model using Canadian cancer registries, administrative databases, and secondary sources.

■ TC22

Level 2 - Room 207

Disease Modeling and Decision Support for Healthcare Delivery

Cluster: Disease Progression

Invited Session

Chair: Eva Lee, Professor and Director, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, evakylee@isye.gatech.edu

1 - Strategies for Vaccine Prioritization

Eva Lee, Professor and Director, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, evakylee@isye.gatech.edu, Fan Yuan

This work is joint with CDC. When limited vaccines are available, prioritized vaccination is considered the best strategy to contain a pandemic. In this work, we derive a mathematical decision framework to track the effectiveness of prioritized vaccination through the course of a pandemic. Our approach couples a disease propagation model with a vaccine queuing model and an optimization engine to determine the optimal prioritized coverage that results in minimum infection and mortality.

2 - Impact of a Potential H7N9 Pandemic Outbreak in the U.S.

Walter Silva Sotillo, PhD Student, University of South Florida/ Pontificia Universidad Catolica del Peru, Industrial and Management Systems Engine, 4202 E. Fowler Avenue, Tampa, FL, 33620, United States of America, silvasotillo@mail.usf.edu, Tapas Das

Till June 27, 2013, WHO reported 131 confirmed cases (with 30% fatality) of influenza in China from bird-to-human transmission of H7N9 virus. Hence, the concern is high that H7N9 may become human-to-human transmittable. We use data from recent reports and a simulation model to predict impact of a potential H7N9 pandemic outbreak in the U.S.

3 - Modeling the Impact of Environmental Cleaning on the Transmission of Multidrug-resistant Organisms

Sean Barnes, University of Maryland, 4352 Van Munching Hall, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu, Daniel Morgan, Anthony Harris, Philip Carling, Kerri Thom

The potential acquisition of multidrug-resistant organisms (MDROs) continues to threaten the safety of patients in many healthcare settings. Environmental contamination can play a significant role, but modeling efforts have minimized or neglected its contribution to overall transmission rates. We develop an agent-based model of the transmission of MDROs in a hospital intensive care unit to compare the impact of environmental cleaning relative to the hand washing practices of healthcare workers.

■ TC23

Level 2 - Room 208A

New Choice Models and Applications

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Metin Cakanyildirim, University of Texas-Dallas, School of Management, 800 W Campbell Road Sm 30, Richardson, TX, 75080, United States of America, metin@utdallas.edu

1 - Optimal Pricing of Two Successive-Generation Products with Trade-in Options under Uncertainty

Rui Yin, Assistant Professor, Arizona State University, W. P. Carey School of Business, Tempe, AZ, 85287, United States of America, Rui.Yin@asu.edu, Hongmin Li, Christopher Tang

We consider a firm who sells two successive generations of a product to forward-looking customers. A trade-in program is offered which allows customers to trade-in the old product and buy the new product at a discounted price. We determine the optimal prices of the two products and examine the effectiveness of the trade-in program.

2 - Information Sharing in Supply Chain of Durable Goods

Hyoduk Shin, UC San Diego Rady School of Management, 9500 Gilman Drive, La Jolla, CA, 92093, United States of America, hshin@rady.ucsd.edu, Neda Khanjari, Seyed Iravani

We study a supply chain of a durable good product consisted of a retailer with advance demand information and a manufacturer. Analyzing how the policy of the retailer to share his information with the manufacturer depends on durability of the product, we show that the retailer strategically shares his demand forecast if and only if the durability of the product is neither too high nor too low. We also present profit implications of the information sharing.

3 - Flexible Products for Dynamic Preferences

Aydin Alptekinoglu, Associate Professor of Supply Chain Management, Pennsylvania State University, University Park, PA, United States of America, aydin@psu.edu, Karthik Ramachandran

Consumers often have needs that change in a dynamic fashion over time due to physiological, mental or environmental variations. We address a product design dilemma in satisfying such dynamic preferences: should a firm offer multiple standard products, each designed for a specific purpose, or a flexible product that can be reconfigured by consumers as their preferences change?

4 - A Choice Model Based on Preferences

Varun Gupta, University of Texas-Dallas, Richardson, TX, United States of America, varun.gupta@utdallas.edu, Metin Cakanyildirim

Willingness to pay (WTP) of customers for a product plays an anchoring role in determining pricing policies of a firm. We propose a WTP-based choice model, which also explicitly models preferences of a customer. Using real-life data, we compare the performance of the proposed model with the multi-choice logit model.

■ TC24

Level 2 - Room 208B

Dynamic Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Stefanus Jasin, Stephen M. Ross School of Business, 701 Tappan St., Ann Arbor, MI, United States of America, sjasin@umich.edu

1 - Non-stationary Stochastic Optimization

Yonatan Gur, Columbia University, 3022 Broadway, New York, NY, 10027, United States of America, ygur14@gsb.columbia.edu, Omar Besbes, Assaf Zeevi

Many revenue management problems may be approached through stochastic approximation algorithms. We consider a family of sequential stochastic optimization problems in which the underlying objective function may exhibit a broad array of temporal changes. Our main results lead to a mapping from budget of variation to achievable performance. Furthermore, we introduce a meta-principle for constructing rate-optimal policies in various settings.

2 - Price Optimization under Two-stage Models

Srikanth Jagabathula, Professor, NYU Stern School of Business, 44 West Fourth Street, KMC Suite 8-74, new york, NY, 10012, United States of America, sjagabat@stern.nyu.edu, Paat Rusmevichientong

We consider the problem of finding optimal prices under the following two-stage model of choice: each incoming customer samples a preference list, a willingness-to-pay, and chooses to purchase the most preferred product according to the sampled preference list among the products whose price is less than that of the sampled willingness-to-pay. This problem is provably hard in general. We propose a PTAS and an algorithm that can be shown to be efficient under reasonable conditions.

3 - A Brownian Model of Dynamic Pricing with Demand Model Uncertainty

Bora Keskin, University of Chicago, Chicago, IL, United States of America, bora.keskin@chicagobooth.edu

We propose a Brownian formulation to address the tradeoff between learning and earning in a dynamic pricing problem with demand model uncertainty. Using stochastic control theory, we solve for the optimal policy of the Brownian model. We discuss how this optimal policy can be employed to design dynamic pricing policies in discrete time formulations, and demonstrate the performance of such policies via simulation.

4 - Real-Time Dynamic Pricing with Minimal and Flexible Price Adjustment

George Chen, University of Michigan, 701 Tappan Street, R0402, Ann arbor, Mi, 48109, United States of America, georgeqc@umich.edu, Izak Duenyas, Stefanus Jasin

We study a dynamic pricing problem in network RM. Two common concerns with dynamic pricing are the expensive optimization and the frequency of price adjustments. To address these, we propose a real-time re-optimization free heuristic. The heuristic can make significant improvement over static pricing by adjusting the price of a small set of products sufficiently rarely. It is also possible to dynamically adjust different sets of products while keeping equivalent revenue.

■ TC25

Level 2 - Room 208C

Problems and Models for Repeated Auctions

Cluster: Auctions

Invited Session

Chair: Michael Katehakis, Professor and Chair, Rutgers University, MSIS Department, 94 Rockafeller Road, Piscataway, NJ, 08854, United States of America, mnk@rutgers.edu

1 - Kidney Exchange: Present and Future

Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15232, United States of America, sandholm@cs.cmu.edu, John Dickerson, Ariel Procaccia

I will share my experiences in designing and developing the algorithms for the UNOS nationwide kidney exchange. I will discuss the main challenges facing kidney exchanges, focusing on the two key dynamics: 1) various natural failures that cause most matches not to go to transplant, and 2) entry and exit of pairs and altruists. I will discuss results from several of our recent papers that tackle optimization under these dynamics.

2 - Expense Constrained Bidder Optimization in Repeated Auctions

Ramakrishna Gummadi, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, gummadi@stanford.edu, Peter Key, Alexandre Proutiere

We consider the online bidding problem of an agent involved in repeated auctions against a stationary random environment. The bidder has expense constraints modeled by a time varying balance and a non-negative income that augments the balance after each auction. For a limiting scenario motivated by sponsored search auction markets, we present a convergence result that reduces the optimal bidding strategy in repeated auctions to its equivalent static version.

3 - Bidding and Learning in Repeated Auctions

S. Karti Puranam, Assistant Professor, La Salle University, 1900 W Olney Ave., Philadelphia, PA, United States of America, puranam@lasalle.edu, Michael Katehakis

We consider the problem of a firm that procures items in repeated auctions by bidding against the "market." The firm and the "market" learn from each winning bid. We study bidding strategies for the firm when the objective of the firm is to minimize the expected total cost of acquiring items to meet demand.

4 - Compostable and Efficient Mechanisms

Vasilis Syrgkanis, PhD Student, Cornell University, Upson Hall, Dept. of Comp.Sci., Ithaca, NY, 14853, United States of America, vasilis@cs.cornell.edu, Eva Tardos

We initiate the study of efficient mechanism design with guaranteed good properties when players participate in multiple different mechanisms simultaneously or sequentially. We define the class of smooth mechanisms and show that they result in high quality outcome in equilibrium both in the full information and in the Bayesian setting, as well as in learning outcomes. Our main result is to show that such mechanisms compose well: smoothness locally at each mechanism implies efficiency globally.

■ TC26

Level 2 - Room 208D

Location Models II

Sponsor: Location Analysis

Sponsored Session

Chair: Oded Berman, University of Toronto, 105 St. George Street, Toronto, ON, M5S 3E6, Canada, Berman@Rotman.Utoronto.Ca

1 - The k-Median Problem on a Network with Random Travel Times and Loss-Averse Customers

Jiamin Wang, Long Island University Post, Roth Hall 202, 720 Northern Blvd, Brookville, NY, 11548, United States of America, Jiamin.Wang@liu.edu, Oded Berman

We consider a network facility location problem where travel times are random variables. Applying the prospect theory to model customers' loss aversion behavior, we develop a mathematical programming model to locate multiple facilities so as to minimize the weighted average of customer disutility due to traveling. We identify a set of dominant points and propose efficient solution procedures. Optimal solutions for different customer behaviors are also compared.

2 - Facility Location for Product Recovery: The Impact of Uncertainty

Wenyi Chen, Zaragoza Logistics Center, Calle Bari 55, Edificio Nayade 5 (PLAZA), Zaragoza, 50197, Spain, wchen@zlc.edu.es, Vedat Verter, Maria Jesus Saenz, Beste Kucukyazici

We present a two-stage stochastic closed-loop supply chain design model that incorporates uncertainties as well as the differences in customer valuations of new and remanufactured products. We integrate SAA with integer L-shaped to tackle the arising mixed integer quadratic program, which we implement in a German company.

3 - Pricing, Location and Capacity Planning with Elastic Demand and Congestion

Oded Berman, University of Toronto, 105 St. George Street, Toronto, ON, M5S 3E6, Canada, Berman@Rotman.Utoronto.Ca, Dmitry Krass

We consider a general version of the stochastic location model with pricing and congestion. Customer demand is elastic in price, travel distance and waiting time; We consider single and multi-facility models with general service discipline, establishing properties including nodal optimality, and (under certain conditions) separability between pricing and locational decisions. This allows us to develop efficient exact optimal solution algorithms.

4 - Case Studies Related to Pre-positioning Supplies for a Hurricane Disaster

Rajan Batta, Professor, University at Buffalo - State University of New York, 410 Bell Hall, Department of Industrial & Systems Engg, Buffalo, NY, 14051, United States of America, batta@buffalo.edu, Bijaya Rath, Gina Galindo Pacheco

This talk discusses case studies that have been developed for pre-positioning supplies for a hurricane disaster event. We use models that have been recently published in the literature. In terms of data sources we use HAZUS, a software developed by FEMA, and forecast data from the National Hurricane Center. Insights from the case studies will be presented along with challenges and opportunities for new models and solution algorithms.

■ TC27

Level 2 - Room 209A

Inventory Management: Procurement and Purchasing

Contributed Session

Chair: Hsin-Chan Huang, The University of Texas at Austin, ETC Building 204 E. Dean Keeton St., Room 5.112, Austin, TX, 78712, United States of America, neo.huang@utexas.edu

1 - The Effect of Contract Pooling on End-of-Life Spare Parts Service

Nicholas Leifker, Assistant Professor, St. John Fisher College, 3690 East Ave., Rochester, NY, 14618, United States of America, nleifker@sjfc.edu, Philip Jones, Timothy Lowe

At the end of a product's life cycle, companies will tend to order or manufacture a final order of spare parts in order to satisfy all future demand for the part. The calculation of this optimal "final order" may be complicated by multiple customers with different contract conditions, including price, contract length, and penalty. We use a dynamic-programming model to determine the optimal order amount as well as post-order decision strategies.

2 - An Economic Order Quantity Model for Items Experiencing Failure in Storage

Mikhail Sher, Ph. D. Candidate, Drexel University, 101 N 33rd Street, Floor 2, Philadelphia, PA, 19104, United States of America, MikhailSher@gmail.com, Dr. Seung-Lae Kim

In this paper, an Economic Order Quantity model for items which experience failure according to a probabilistic rate during the storage period is developed. The model presented in this paper is applicable to systems with large fixed order costs and lengthy inventory holding periods. The paper first develops an Economic Order Quantity model for the presented framework. Illustrative numerical examples which demonstrate the effects of certain model parameter changes are then provided.

3 - Order Quantity Optimization in Stochastic Environment

Uladzimir Rubasheuski, PhD Student, Molde University College, Britvegen 2, Molde, 6429, Norway, uladzimir.rubasheuski@himolde.no

The presented problem reflect the optimization of the single order quantity taking in consideration transportation costs. The system analyzed is characterized by long total lead times, which are significantly larger than the replenishment cycles. Stochastic programming approach is used to deal with the problem.

4 - Effects of Demand Aggregation and Bin Quantities on an In-Plant Just-in-Time Parts Supply System

Hsin-Chan Huang, The University of Texas at Austin, ETC Building 204 E. Dean Keeton St., Room 5.112, Austin, TX, 78712, United States of America, neo.huang@utexas.edu, Erhan Kutanoglu

We analyze an in-plant parts supply system for class C parts used in a plant of multiple engine assembly lines. A part, which may be used in several workstations with various demand rates, is ordered based on the overall demand and delivered to stations in boxes from the plant warehouse. We derive a formula for the extra inventory needed to control the risk of not satisfying all workstation demands due to aggregation and bin quantities and provide insights into how the system compares to others.

■ TC28

Level 2 - Room 209B

Strategic Behavior in Large Scale Systems

Cluster: Cloud Computing

Invited Session

Chair: Adam Wierman, Professor, California Institute of Technology, 1200 E California Blvd MC 305-16, Pasadena, CA, 91125, United States of America, adamw@caltech.edu

1 - The Economics of the Cloud: Price Competition and Congestion

Yunjian Xu, Singapore University of Technology and Design, Engineering Systems and Design, Singapore, Singapore, xuyunjian@gmail.com, Jonatha Anselmi, Danilo Ardagna, John C.S. Liu, Adam Wierman, Zichao Yang

This paper proposes a model to capture a marketplace with users purchasing services from Software-as-Service (SaaS) providers, which in turn purchase computing resources from either Provider-as-a-Service (PaaS) providers or Infrastructure-as-a-Service (IaaS) providers. We define and characterize market equilibria. Further, we use these characterizations to study the profitability of SaaSs and PaaSs/IaaSs, and to understand the impact of price competition on user experienced performance.

2 - Large-scale Service Marketplaces: The Role of the Moderating Firm

Eren Cil, Assistant Professor, University of Oregon, 1208 University of Oregon, Eugene, OR, 97403-1208, United States of America, erencil@uoregon.edu, Gad Allon, Achal Bassamboo

In this paper, we study the behavior of the agents and customers in a large-scale service marketplace. Our main goal is to discuss the role of the moderating firm in facilitating information gathering, operational efficiency, and communication among agents. Surprisingly, operational efficiency may be detrimental to the overall efficiency of the market-place. We show that to reap the gains of operational efficiency the firm may need to complement it by enabling communication among its agents.

3 - Service Differentiation in Large-Scale Systems

John Yao, Columbia University, New York, NY, United States of America, jyao14@gsb.columbia.edu, Costis Maglaras, Assaf Zeevi

We consider the problem of a monopolistic service provider who offers a menu of services to a market of heterogeneous price- and delay-sensitive customers. We highlight how a simple deterministic problem reveals the heavy-traffic operating regime induced by the revenue maximizing or social welfare maximizing optimal policy. Moreover, we show that the optimal service offering may be well-approximated by one with many fewer service classes.

4 - Payment Incentives to Trade-off Speed and Quality in Large Service Systems

Amy Ward, Associate Professor, University of Southern California, Marshall School of Business, Bridge Hall 401H, Los Angeles, CA, 90089, United States of America, amyward@marshall.usc.edu, Dongyuan Zhan

In service systems, it is important that customers have both low wait times and good quality of service. However, in human-intensive services like call centers, there can be tension between serving customers quickly (which reduces wait times) and providing better service quality by spending more time with each customer (which increases wait times). We propose a payment scheme whose purpose is to guide each agent's speed-quality trade-off decision.

■ TC29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - Frontline Systems, Inc. – Integrated Data Mining, Simulation and Optimization in Microsoft Excel

Daniel Fylstra, Frontline Systems, Inc., P.O. Box 4288, Incline Village, NV, 89450, United States of America, daniel@solver.com

Analytic Solver Platform in Microsoft Excel has everything you need for forecasting and data mining, Monte Carlo simulation and risk analysis, and conventional and stochastic optimization. See how you can use it to build your own analytic expertise, teach others using leading textbooks, build industrial-scale models, and communicate business result.

2 - Syncopation Software – DPL Products

Tony Manzella, Syncopation Software, Bangor, ME, 04401, United States of America, tmanzella@syncopation.com

This demonstration will explore the full range of DPL products. With DPL 8's new Excel add-in interface, performing a quick analysis on a spreadsheet takes just a few clicks, all right in Excel's ribbon (yes, your students will figure this out themselves). Moving beyond the basics, DPL's advanced Fault Trees and flexible objective functions make quick work of tough security problems. Need to make that decision 100 times? DPL's Portfolio version has you covered.

■ TC30

Level 2 - Room 210B

Convex Optimization

Contributed Session

Chair: Mutiara Sondjaja, Cornell University, 206 Rhodes Hall, Ithaca, NY, 14853, United States of America, ms999@cornell.edu

1 - Conic Approximation to Nonconvex Quadratic Programming with Convex Quadratic Constraints

Zhibin Deng, North Carolina State University, 2824 Avent Ferry Rd., Apt. 302, Raleigh, NC, 27606, United States of America, zdeng2@ncsu.edu, Shu-Cherng Fang, Tiantian Nie

A conic reformulation and approximation is proposed for solving a nonconvex quadratic programming problem subject to several convex quadratic constraints. The original problem is transformed into a linear conic programming (LCOP) problem, which can be approximated by a sequence of linear conic programming problems over the dual cone of the cone of nonnegative quadratic functions. Each LCOP problem can be solved efficiently using SDP.An adaptive scheme is adopted to speed up the convergence.

2 - A Variant of the Spectral Projected Gradient Method for SDP with Log-determinant and l_1 Norm Terms

Mituhiro Fukuda, Associate Professor, Tokyo Institute of Technology, 2-12-1-W8-41 Oh-okayama, Meguro-ku, 152-8552, Japan, mituhiro@is.titech.ac.jp, Makoto Yamashita, Takashi Nakagaki

The sparse covariance selection problem is one of representative problems which can be described by an SDP problem with log-determinant and l_1 norm terms in the objective function. Several methods to solve it has been proposed such as proximal point method, alternating linearization method, adaptive spectral projected gradient method, etc. We propose a novel variant of the spectral projected gradient method which provides very encouraging computational results if compared to the exiting ones.

3 - An Algorithm for Solving Basis Pursuit Denoising Problem

Sahar Karimi, University of Waterloo, 200 University Ave. W., Waterloo, ON, N2L3G1, Canada, s2karimi@uwaterloo.ca, Stephen Vavasis

Basis pursuit denoising problem (BPDN), also known as l_1 regularized least square problem, arises in many practical applications including sparse recovery in compressive sensing, machine learning and statistics. In this talk we are presenting a proximal quasi-Newton type method for solving the aforementioned problem. Practical efficiency of our method is tested, and its results suggest that the proposed algorithm compares favorably with the other state-of-the-art solvers.

4 - A Quadratic Cone Relaxation-based Algorithm for Linear Programming

Mutiara Sondjaja, Cornell University, 206 Rhodes Hall, Ithaca, NY, 14853, United States of America, ms999@cornell.edu, James Renegar

We present and analyze a linear programming algorithm based on replacing the non-negative orthant with larger quadratic cones. For each quadratic relaxation that has an optimal solution, there naturally arises a parameterized family of quadratic cones for which the optimal solutions create a path leading to the LP optimal solution. We show that this path can be followed efficiently, thereby resulting in an algorithm whose complexity matches the best bounds proven for interior-point methods.

■ TC31

Level 2 - Room 211A

Methods in Financial Risk Management

Sponsor: Financial Services

Sponsored Session

Chair: James Primbs, Associate Professor, University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, jap120030@utdallas.edu

1 - CVaR Absolute Norm: Stochastic Case

Alexander Mafusalov, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, mafusalov@ufl.edu, Stan Uryasev

CVaR absolute norm is CVaR of absolute value of a random variable. It is defined in two variations: scaled and non-scaled. L1 and L-infinity norms are limiting cases of the new family of norms. Several properties for CVaR absolute norm as functions of confidence parameter were proved. Dual norm for CVaR absolute norm is found. CVaR absolute norm as a Measure of Error generates a Regular Risk Quadrangle. Linear regression problems were solved by minimizing CVaR absolute norm of noise.

2 - Estimation of Mixtures of Continuous Distributions: Mixtures of Normal and Applications

Victoria Zdanovskaya, Research Assistant, University of Florida, Department of Industrial and Systems Engineering, 303 Weil Hall, PO Box 116595, Gainesville, FL, 32611, United States of America, ladyvi@ufl.edu, Konstantin Pavlikov, Stan Uryasev

Mixtures of continuous distributions can approximate different probability distributions. This paper suggests computationally efficient methods for constructing mixtures of distributions, based on the minimization of weighted Kolmogorov-Smirnov distance and CVaR-distance between CDFs of an empirical distribution and the mixture. A special attention is paid to fitting tails of the distribution. Proposed techniques are exemplified with fitting the distribution of an aircraft manufacturer errors.

3 - A Receding Horizon Approach to the Trading of Autocorrelated Returns under Transaction Costs

James Primbs, Associate Professor, University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, jap120030@utdallas.edu

We consider the problem of optimally trading returns that are autocorrelated when transaction costs and other constraints are present. We develop an efficient suboptimal receding horizon algorithm in which a quadratic program is computed at each rebalancing opportunity. Numerical results demonstrate the performance of the approach.

4 - Approximation of Discrete Distributions: Model Randomization and Building Scenarios

Stan Uryasev, Professor of Industrial and Systems Engineering, University of Florida, 303 Weil Hall, PO Box 116595, Gainesville, FL, 32611, United States of America, uryasev@ufl.edu, Konstantin Pavlikov

We approximate a discrete random variable by some other discrete random variable with unknown probabilities of outcomes. The probabilities of atoms of the new distribution are obtained by minimizing Kolmogorov-Smirnov, Kantorovich, and CVaR absolute distance between distributions. We consider two applications: 1) Randomizing deterministic models in Financial Engineering; 2) Constructing scenarios for stochastic programming.

■ TC32

Level 2 - Room 211B

Outsourcing and Offshoring Innovation

Sponsor: Technology Management

Sponsored Session

Chair: Saikat Chaudhuri, Assistant Professor of Management, University of Pennsylvania, The Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, saikatc@wharton.upenn.edu

1 - Managing Complexity and Uncertainty in Offshore Outsourced New Product Development Projects

Saikat Chaudhuri, Assistant Professor of Management, University of Pennsylvania, The Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, saikatc@wharton.upenn.edu, Abhijit Mandal

Motivated by its rising prominence, we investigate to what extent the offshore outsourcing approach can effectively transfer to complex and uncertain knowledge-intensive work like R&D, by developing a simulation model based on a sample of such projects by a leading vendor. We contrast the global delivery model with a consulting model, and find that each approach is more efficacious at handling different types of tasks, bearing implications for notions of firm boundaries and organizational forms.

2 - Vendor Selection, Contract Efficiency, and Performance Measurement in Outsourcing

Zhijian Cui, Assistant Professor of Operations Management, IE Business School, Calle de Maria de Molina, 12, Madrid, Spain, Zhijian.Cui@ie.edu, Sameer Hasija

This study compares the efficacy of some commonly observed vendor selection and contracting mechanisms with respect to two key challenges in outsourcing of information and knowledge intensive service processes: vendor selection and contract efficiency. We also highlight the implications of performance-based contracts in services.

3 - Impact of Interorganizational Coordination and Quality Metrics In Offshore Execution of Processes

Ravi Aron, Associate Professor, Johns Hopkins University, 100 International Drive, Room 1331, Baltimore, MD, 21202, United States of America, raviaron@jhu.edu, Praveen Pathak

We study the use of interogranizational information systems (IIS) that allow the flow of information as well as the exerting of managerial control across the boundaries of the firm and their impact on the quality of work executed offshore in knowledge-intensive processes such as in Drug Trials. We find that the use of IIS is positively associated with higher levels of quality of work unlike the use of managerial control and that the knowledge intensity of the work plays a moderating role.

4 - How Does Buyer's Knowledge Impact Outsourcing Strategies? A Game Theoretic Model

Qiong Chen, Clemson University, 100 Sirrine Hall, Clemson University, Clemson, SC, 29634, United States of America, qiongc@clemson.edu, Shouqiang Wang, Gulru Ozkan, Aleda Roth

We introduce a signaling game to examine the outsourcing strategies of a buying firm that faces two options in determining a manufacturer to produce its new product: search directly or indirectly (through an intermediary). We demonstrate that buyer's knowledge about supply market influences its strategy and the intermediary's effort level.

■ TC33

Level 2 - Room 211C

OR Modeling of Decentralized UAV Routing Problems

Cluster: Homeland Security/Defense

Invited Session

Chair: Chase Murray, Auburn University, Industrial & Systems Engineering, Auburn, AL, United States of America, ccm0022@auburn.edu

1 - A Game Theoretic Approach to UxV Routing and the Price of Anarchy Associated with Decentralization

Michael Couche, University at Buffalo, 342 Bell Hall, University at Buffalo, Buffalo, NY, 14260, United States of America, mjcouche@gmail.com

The use of UxV's is becoming increasingly popular in the military. We aim to analyze several two-player games under different conditions in order to route UxV's. We will then compute the loss of information between these games when compared to a centralized routing framework to identify "best practice" rules when routing.

2 - Simultaneously Determining Entry/Egress Points and Time Allocations for UAV Grid Routing

Michael Moskal, PhD Student, University at Buffalo (SUNY), 342 Bell Hall, Department of Industrial & Systems Eng, Amherst, NY, 14260, United States of America, mmoskal@buffalo.edu, Rajan Batta

In this work we propose a method for simultaneously determining the best entry/egress points and the time allocations to maximize information gain on UAV surveillance missions. Given a route, each grid can be decomposed into a network and a series of routing and algorithms and heuristics can estimate the expected information gain. A math model is then used to determine the entry/egress points and the amount of time that should be spent in each grid to maximize information gain.

3 - UAV Search Optimization under Uncertain Reward

Yan Xia, Industrial and System Engineering Department, University at Buffalo, 342 Bell Hall, Buffalo, NY, 14260-2050, United States of America, yanxia@buffalo.edu, Rajan Batta, Rakesh Nagi

This talk develops a stochastic and dynamic model of the time allocation problem for a UAV search mission. Reward is not deterministic. Instead, a random event during the search determines reward. Upper bounds and a concavity result allow development of an efficient optimal procedure. We numerically compare the reward under the optimal strategy and under two human intuitive strategies, and find significant optimality gaps in both planning horizon and searching horizon.

4 - Optimization Heuristics for the Decentralized Coordination of Resources to Improve Border Security

Hector Ortiz-Pena, CUBRC, Inc, 4455 Genesee St., Buffalo, NY, 14221, United States of America, hector.ortiz-pena@cubrc.org, Rakesh Nagi, Mark Karwan, Michael Hirsch, Moises Sudit

Efficient coordination of limited and distributed resources gathering information about illegal activities has become critically important for a safe and secure border environment. We have developed a multi-perspective mathematical programming model to maximize information gain from resources performing surveillance. Disruption of communication between resources is minimized. Computational experiments are presented showing our performance evaluation of developed heuristics.

■ TC34

Level 2 - Room 211D

Simulation-based Optimization

Sponsor: Simulation Society

Sponsored Session

Chair: Jing Xie, Cornell University, Ithaca, NY, United States of America, jx66@cornell.edu

1 - Optimal Information Blending with Measurements in the L-2 Sphere

Boris Defourny, Post-doctoral associate, Princeton University, Sherrerd Hall, Princeton, NJ, 08544, United States of America, defourny@princeton.edu, Ilya Ryzhov, Warren Powell

We consider a sequential information collection problem where a risk-averse decision-maker updates a Bayesian belief about the unknown objective function of a linear program. The information comes as a linear combination of the objective coefficients, to be selected. Because the belief determines the uncertainty set of a robust linear program used to optimize a worst-case performance, the information collection problem is affected by the possible evolution of the uncertainty set.

2 - Adaptive Random Search with Discarding for Continuous Simulation-based Optimization

Liujia Hu, PhD candidate, Georgia Institute of Technology, 765 Ferst Drive, NW, Groseclose Bldg. Room 344, Atlanta, GA, 30332, United States of America, lhu9@gatech.edu, Sigrun Andradottir

We propose an Adaptive Search with Resampling and Discarding (ASRD) approach for solving stochastic optimization problems with uncountable feasible regions. ASRD is a framework for designing algorithms that are adaptive both in seeking new points and in keeping or discarding already sampled points. We present conditions under which ASRD is convergent almost surely and provide numerical results showing that ASRD is promising, especially for difficult problems with large numbers of local optima.

3 - A Bayesian Subset Selection Method and Application to Transportation Simulation-based Optimization

Franco Chingcuanco, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 1-245, Cambridge, MA, 02139, United States of America, fchingcu@mit.edu, Carolina Osorio

We extend the Bayesian value of information procedure to problems of selecting the best m out of k alternatives, where the performance of an alternative is evaluated via a stochastic simulator. The method uses an economic opportunity cost loss function and considers all m-sized subsets as the underlying alternatives. The method is compared to that of other subset selection methods. It is then embedded within a simulation-based optimization algorithm to address an urban transportation problem.

4 - Shape-constrained Estimation of Value Functions

Mohammad Mousavi, Stanford University, 140 Ayrshire Farm Lane#103, Stanford, CT, 94305, United States of America, mousavi@stanford.edu, Peter Glynn

We present a non-parametric method to estimate the value function, via simulation, in the context of expected infinite horizon discounted rewards for Markov chains. Estimating such value functions plays an important role in approximate dynamic programming. We incorporate "soft information" into the estimation algorithm, such as knowledge of convexity, monotonicity, or Lipchitz constants. In the presence of such information, a nonparametric estimator for the value function can be computed that is provably consistent as the simulated time horizon tends to infinity. We also discuss extensions of this idea, and related computational issues.

■ TC35

Level 2 - Room 212A

Social Influence in Online Environments

Sponsor: E-Business

Sponsored Session

Chair: Dylan Walker, Boston University, School of Management, 595 Commonwealth Ave., Boston, MA, 02215, United States of America, dtwalker@bu.edu

1 - Clustered Graph Randomization: Network Exposure to Multiple Universes

Johan Ugander, Cornell University, Rhodes Hall, Ithaca, NY, 14853, United States of America, jhu5@cornell.edu, Brian Karrer, Lars Backstrom, Jon Kleinberg

A/B testing is a standard approach for evaluating the effect of online experiments, but it is poorly suited for experiments involving social interference, when the treatment of individuals spills over to neighbors in a social network. In this work, we propose a novel methodology for using graph clustering to analyze experimental treatment effects under social interference, including graph-theoretic conditions under which individuals can be considered to be 'network exposed' to an experiment.

2 - Identity and Opinion: A Randomized Experiment

Sean Taylor, New York University, 44 West 4th Street, New York, NY, United States of America, staylor@stern.nyu.edu, Sinan Aral, Lev Muchnik

Social media content such as tweets and comments are usually displayed with the identity of the user who creates them. The associated social context links content quality and creator identity, making it difficult to separate their effects on content interactions such as rating and discourse. We conducted a randomized experiment on a news discussion website, randomly omitting commenter identity for 5% of comments and allowing us to attribute interactions to identity features only.

3 - The Impact of Social Media on Television Viewership: Evidence from a Large Scale Natural Experiment

Dylan Walker, Boston University, School of Management, 595 Commonwealth Ave., Boston, MA, 02215, United States of America, dtwalker@bu.edu, Lev Muchnik

The rapid growth of online social media has significantly altered the way that we consume, process and diffuse information. Social media posts on twitter prominently feature discussions about and reactions to scripted televised content. We estimate the causal impact of twitter discourse on television viewership in a large scale natural experiment that measures actual content through NLP techniques and leverages the exogenous lag of premiered televised programming across geographic markets.

■ TC36

Level 2 - Room 212B

Public-Sector Decision Modeling Applications

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Michael Johnson, Associate Professor, University of Massachusetts Boston, Dept of Public Policy and Public Affairs, 100 Morrissey Blvd., Boston, MA, 0212503393, United States of America, michael.johnson@umb.edu

1 - Parcel-level Redevelopment Strategies for Distressed Neighborhoods

Michael Johnson, Associate Professor, University of Massachusetts Boston, Dept of Public Policy and Public Affairs, 100 Morrissey Blvd., Boston, MA, 0212503393, United States of America, michael.johnson@umb.edu, Justin Hollander

Certain distressed neighborhoods cannot support traditional residential-focused development. For these communities, we develop decision models for acquisition and redevelopment of chronically vacant lands and structures for primarily non-residential and greening uses. We address social benefits and costs of redevelopment strategies, parcel clustering to exploit economies of scale, and conflicting values among various stakeholders. We illustrate our models using data from Baltimore, MD.

2 - Improving the Distribution System for the Food for Kids Backpack Program at the RFBO

Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu

The Regional Food Bank of Oklahoma (RFBO) is a major non-profit organization providing food to people at no cost in Oklahoma. This paper presents a new distribution system designed for one of the programs of the RFBO; the Food for Kids Backpack program (FKBP). The model is expected to result in considerable savings and a more efficient staff workload.

3 - Analyzing K-12 Education as a Complex System

Pratik Mital, Ph.D. Student, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, pratik_mital@gatech.edu, Donna Llewellyn, Douglas Edwards, Roxanne Moore

Schools and school districts are complex, dynamic systems affected by numerous factors, specific to the particular environment. A framework is developed that describes the system in terms of both actors and the attributes of those actors and will become the foundation for identifying a subset of attribute combinations that allow for successful change in the system. An agent based model is developed that analyzes the barriers and enablers to school change and reform.

4 - Improving Volunteer Productivity and Retention during Humanitarian Relief Efforts

Kevin Taaffe, IE Graduate Coordinator and IIE Faculty Advisor, Clemson University, 130-A Freeman Hall, Clemson, SC, 29634, United States of America, taaffe@clemson.edu, Kyle Lassiter, Abdelwahab Alwahishie

After a disaster, humanitarian organizations quickly assemble a workforce to serve a community's needs. However, these needs and the volunteer base can change over time. We compare the use of two volunteer assignment methods: a scenario-based math programming model and a system dynamics model. We examine the changes in volunteer assignments based on several key cost parameters, need likelihood scenarios, and volunteer training opportunities. Numeric examples are then presented and discussed.

■ TC37

Level 2 - Room 213A

Robust Project Scheduling

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Erik Demeulemeester, Professor, KU Leuven, KBI - Research Center for Operations Man, Naamsestraat 69, Leuven, B3000, Belgium, Erik.Demeulemeester@kuleuven.be

1 - A Robust One-phase Scheduling Method for the RCPSP with Stochastic Activity Durations

Patricio Lamas, KU Leuven, Naamsestraat 69 - Box 3555, Leuven, 3000, Belgium, Patricio.LamasVilches@kuleuven.be, Erik Demeulemeester

The RCPSP with stochastic activity durations involves the determination of a proactive schedule. Traditional robust methods are two-phases: first they fix the resource network and secondly they make the schedule robust. We propose a one-phase method that minimizes the project makespan s.t. a risk level. Results show that there exists a clear relation between risk and the two classical measures (solution and quality robustness). We compare our approach with two published methods.

2 - A Genetic Algorithm for the Robust Resource Leveling Problem

Hongbo Li, Beihang University; KU Leuven, Xueyuan Road 37, Beijing, 100191, China, hongbo.li@student.kuleuven.be, Erik Demeulemeester

We study the robust resource leveling problem (RRLP) in which the activity durations are stochastic and the objective is to obtain a robust baseline schedule that minimizes the expected positive deviation of both resource utilization and activity starting time. We present a genetic algorithm (GA) for the RRLP. To demonstrate the effectiveness of our GA, we conduct extensive computational experiments on a set of randomly generated test instances and investigate the impact of different factors.

3 - Incorporate Activity Sensitivity Measures into Buffer Management to Manage Project Schedule Risk

Xue jun Hu, HuaZhong University of Science and Technology, School of Management,1037 Luoyu Road, Wuhan, 430074, China, huxuejun0626@foxmail.com, Nan fang Cui

A new buffer monitoring method is proposed by introducing activity based sensitivity measures (i.e. the Cruciality index) in a traditional PERT framework into the critical chain buffer management approach for the purpose of more efficiently managing project schedules and coping with schedule risk. Results of an experimental application are given to illustrate the superiority of the proposed method in terms of management control efforts and the tracking efficiency.

4 - Analytically Establishing the Bounds the Alphorn of Uncertainty in Project Scheduling

Peter D Simonson, Adjunct Professor, North Dakota State University, Richard H Barry Hall, PO Box 6050, Fargo, ND, 58108, United States of America, psimonson@mac.com, Joseph Szmerekovsky

The purpose of this paper is to establish the bounds of the "Alphorn of Uncertainty" for a project. If the duration of an activity is a random variable then the cost associated with that activity is also a r.v. and thus the range of cost outcomes at any give time can be bordered by an upper and lower bound. This range forms an "alphorn" getting wider as the duration of the project increases. Further, we investigate the complexity of calculating the Alphorn of Uncertainty exactly.

■ TC38

Level 2 - Room 213B

Supply Chain: Inventory Management

Contributed Session

Chair: Georg Schorpp, Stanford University, 475 Via Ortega, Stanford, United States of America, gschorpp@stanford.edu

1 - Contracting for Vendor-Managed Inventory with Stockout-Cost Sharing

Jun-Yeon Lee, California State University, Northridge, 18111 Nordhoff St., Northridge, CA, 91330-8378, United States of America, junyeon.lee@csun.edu, Richard Cho

We examine the problem of designing a vendor-managed inventory (VMI) contract in a (Q, r) inventory system between a supplier and a retailer. The contract specifies that the supplier pays a fixed and proportional penalty to the retailer when stockouts occur at the retailer. For the deterministic demand we characterize the optimal contract for the retailer. Our computational study for the deterministic and stochastic demand provides several interesting results.

2 - An Integral Planning System for a Global Pharmaceutical Company

Roberto Enrique Uquillas Andrade, Doctoral Candidate, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612 AZ, Netherlands, r.e.uquillas.andrade@tue.nl

In this study, the tangible benefits and operational validity of implementing an integral planning system are analyzed. Multi-echelon models for positioning stock of relevant products are developed, and the implications in the target stock setting process are analyzed. The study demonstrates that the integration through planning activities would imply lower capital investment. In addition, procedures for modeling different aspects of the supply network have been developed.

3 - Lateral Transshipment and Rationing Policies for Multi-Retailer Systems

Zumbul Atan, Technical University of Eindhoven, Den Dolech 2, Eindhoven, Netherlands, z.atan@tue.nl, Lawrence V. Snyder, George Wilson

We study a multi-retailer system with each retailer serving to two types of customers. Each retailer employs a rationing, critical level, continuous review (r,Q) policy with lost sales. Retailers can transship items from either other retailers or a central depot. We propose an iterative heuristic, which relies on adjusting the demand rates and the missed-demand costs of both types of customers at all retailers, to solve the overall rationing and transshipment problem.

4 - Supply Chain Management through Cascading

Georg Schorpp, Stanford University, 475 Via Ortega, Stanford, United States of America, gschorpp@stanford.edu, Hau L. Lee, Feryal Erhun

We consider a two-player supply chain where disruptions of random length can occur at the supplier. Both the buyer and the supplier have access to individual emergency sources and can reserve extra capacity from their respective emergency source before learning the disruption length. We investigate the inefficiency gap and the conditions under which the supply chain can be aligned such that the total capacity in the decentralized equals the capacity in the centralized supply chain.

■ TC39

Auditorium 3

Joint Session RAS/TSL: High-Speed Rail Capacity Analysis

Sponsor: Railway Applications & Transportation Science & Logistics

Sponsored Session

Chair: Kuilin Zhang, Argonne National Laboratory, 9700 S Cass Ave., Argonne, IL, 60439, United States of America, klzhang@u.northwestern.edu

1 - Strategies for Intermingling of High Speed and Legacy Railway Services

Steven Harrod, Assistant Professor, University of Dayton, 1143 Ashburton Dr., Dayton, OH, 45459, United States of America, a2soft@aol.com

Most proposals for high speed railway services in North America seek to intermingle high speed passenger services with existing conventional railway services on shared routes. This presentation discusses how these various proposals plan to address specific operating plans and technology. The session will present details on operating rules and modifications to the infrastructure for each system. Relevant European shared network operations will also be presented.

2 - Capacity Assessment on a Rail Network: A Maximum Network Flow based Formulation

Xuesong Zhou, University of Utah, MCE Building 2135, 110 S. Central Campus Dr., Salt Lake City, UT, 84112, United States of America, xzhou99@gmail.com, Lingyun Meng

The rail network capacity can be defined as the maximum train paths that can be operated on a rail network within a time period under given train characteristics and level of service (LOS). This talk presents a maximum network flow based linear programming formulation to estimate the network capacity subject to different given LOS constraints. The model is solved by a Lagrangian relaxation algorithm on a number of real-world test cases.

3 - Optimal Siding Location Model for Mixed-use Rail Corridors
Mei-Cheng Shih, Graduate Research Assistant, University of Illinois RailTEC, B118 Newmark Lab, 205 N Mathews Ave., Urbana, IL, 61801, United States of America, mshih2@illinois.edu, Tyler Dick

Many mixed-use single-track rail lines in North America are expected to reach their capacity due to the increasing demand for higher-speed passenger traffic. This research aims to develop an Optimal Siding Location Model to determine the optimal number and location of new sidings to add to rail lines with consideration of traffic characteristics and infrastructure properties. This decision support tool can help maximize the benefits of siding expansion projects.

4 - Freight Transportation In Turkish State Railways (TCDD) High-Speed Train System
Alp Ertem, Cankaya University, Eskisehir Yolu 29.km Yenimahalle, Ankara, 06810, Turkey, alpertem@gmail.com, Merve Keskin

High speed trains (HSTs) are faster than trucks and cheaper than airlines for freight transportation. Freight is added to the existing HST system of Turkey which is currently used only for passengers. A scheduling model is constructed to observe the effects of freight transportation in two cases: adding separate freight trains to the system and using the same trains with passengers for freight transportation. Several factors were determined to choose between two cases at certain conditions.

5 - Impact of High-Speed Passenger Trains on Freight Train Efficiency in Shared Railway Corridors
Kuilin Zhang, Argonne National Laboratory, 9700 S Cass Ave., Argonne, IL, 60439, United States of America, klzhang@u.northwestern.edu, Yanfeng Ouyang

The U.S. has begun development of high-speed rail (HSR) services since 2009. Many of planned or proposed HSR systems use shared corridors in which freight and passenger trains with heterogeneous configurations and operating characteristics will use the same tracks. This talk will present a decision support model that can help evaluate the impact of high-speed passenger trains on freight corridor capacity.

■ TC40

Auditorium 2

Transit System Modeling II: Routing

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Qianfei Li, PhD Candidate, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, qianfei-li@u.northwestern.edu

1 - Transit Route Choice with Partial Arrival Information at Stops
Peng Chen, Northwestern University, Evanston, IL, United States of America, chenp07@gmail.com, Yu Nie, Qianfei Li

In this paper, we propose a method to determine the probability of boarding each line at a stop when arrival information of only a subset of available lines is provided to passengers. The impact of information availability will be illustrated with small numerical examples.

2 - Transit Hyperpath under General Headway Distribution
Qianfei Li, PhD Candidate, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60201, United States of America, qianfei-li@u.northwestern.edu, Peng Chen, Yu Nie

In hyperpath algorithm, the attractive set is obtained in closed form because of Exponential headway assumption, which is difficult to justify both in theory and real data. The data from Chicago Transit Authority (CTA) indicates that log-logistics, Gamma and Erlang distribution are better alternatives. Hyperpath algorithm is conducted based on Erlang distribution due to its special properties. Our results indicate that Erlang distribution generate different hyperpath from Exponential.

3 - Routing to Prevent Congestion in Rail-Based AMHS Systems
Kelly Bartlett, Doctoral Candidate, Georgia Institute of Technology, 765 Ferst Dr., Atlanta, GA, United States of America, kelly.bartlett@gatech.edu, George Nemhauser, Shabbir Ahmed, Joel Sokol, Junho Lee, Bungsoo Na

In rail-based Automated Material Handling Systems (AMHS), such as those used to transport wafers in semi-conductor manufacturing, vehicular congestion results in reduced production efficiency. We present vehicle routing strategies to prevent congestion including dynamic routing, where routes are adjusted based on current congestion, and intentional route distribution using a multi-commodity flow model. We provide results from a simulated prototype facility.

■ TC41

Level 1 -101A

Joint Session MSOM/BOM: Behavioral Operations

Sponsor: Manufacturing & Service Operations Management & Behavioral Operations Management

Sponsored Session

Chair: Ruben Lobel, University of Pennsylvania, The Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu

1 - Push, Pull, or Both? A Behavioral Study of Inventory Risk on Supply Chain Performance
Andrew Davis, Assistant Professor, Cornell University, Ithaca, NY, 14853, United States of America, adavis@cornell.edu, Elena Katok

We experimentally investigate how the allocation of inventory risk affects supply chain performance. We first evaluate two wholesale price contracts that differ in which party holds the inventory and develop a behavioral model. We then apply this model to a third contract and find that it qualitatively matches behavior.

2 - Trust, Trustworthiness and Information Sharing in Supply Chains Bridging China and the U.S.
Ozalp Ozer, Professor, The University of Texas at Dallas, Naveen Jindal School of Management, 800 West Campbell Road, Richardson, TX, 75080, United States of America, oozer@utdallas.edu, Yufei Ren, Yanchong Zheng

We experimentally study how cultural distinctions between China and the U.S. affect the efficiency of information sharing and operational decisions in global supply chains. We show how spontaneous trust and trustworthiness are lower in China than in the U.S., and Chinese show higher trust towards U.S. partners. The two populations exhibit drastically different behavioral dynamics under repeated interactions, rendering a Chinese supply chain to benefit more from a long-term relationship.

3 - Bounded Rationality in a Two-tier Supply Chain
Basak Kalkanci, Massachusetts Institute of Technology, Boston, MA, United States of America, kalkanci@mit.edu, Georgia Perakis

We examine models that incorporate a spectrum of behavior (fully rational versus boundedly rational) in a supplier-retailer dyad. We show that the supplier's and retailer's profit are not monotone in the retailer's rationality: the supplier may prefer that either the retailer makes very noisy decisions or that she is an optimizer. We quantify how much is lost by assuming perfect rationality and the value of using minimax regret criterion when the retailer's rationality is not known.

4 - Contracts and Product Choice
Wedad Elmaghraby, Associate Professor, University of Maryland, RH Smith School of Business, Van Munching Hall Room 4352, College Park, MD, 20742-1815, United States of America, wedad_elmaghraby@rhsmith.umd.edu, Anna Devlin, Rebecca Hamilton

In this research we study experimentally whether or not the type of contract offered influences the retailer's choice between two products where one product is obviously riskier. We hypothesize that when offered a risk reducing contract, the retailer will be more likely to select the riskier product as compared to a case when he is offered a wholesale price contract. These findings could have implications for future contract design as well as product assortment.

■ TC42

Level 1 -101B

Supply Management and Operations/ Financial Decisions

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Guoming Lai, University of Texas at Austin, 2110 Speedway, Austin, 78712, United States of America, guoming.lai@mccombs.utexas.edu

1 - Procurement Contracting under Product Recall Risk
Gang Wang, University of North Carolina at Chapel Hill, Kenan-Flagler Business School, Campus Box 3490, McColl Building, Chapel Hill, NC, 27599, United States of America, gang_wang@unc.edu, Karthik Natarajan, Lauren Xiaoyuan Lu

We examine a procurement contracting setting where a manufacturer and a supplier share product recall cost. We characterize the optimal contract that the manufacture should offer and the optimal quality and capacity decisions that the supplier would take under the contract.

2 - How Fast Should a Cash Constrained Firm Grow? Strategies that Balance Growth and Survival

Yasin Alan, Assistant Professor of Operations Management, Vanderbilt University, Owen School, 401 21st Ave. S, Nashville, TN, 37203, United States of America, Yasin.Alan@owen.vanderbilt.edu, Vishal Gaur

A cash constrained firm has to balance growth and survival when making its operational and borrowing decisions. We study the operational implications of this trade-off in a finite horizon cash-constrained inventory model with non-stationary demand, which is a function of the firm's past order quantities. We analyze four growth scenarios to capture the impact of financing constraints and the bankruptcy process on the firm's stocking decisions.

3 - Sell or Lease? Stories on Electric Cars and Textbooks

Yangfang Zhou, Assistant Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Rd., Singapore, 178899, Singapore, helenzhou@smu.edu.sg

We investigate the problem of whether to sell or lease products by considering the strategic customer behavior of waiting. Two examples of such products are electric vehicles and textbooks. We examine how this decision (sell or lease) is affected by the customer impatience and the rate of product cost reduction. We find that under certain conditions, it is even more valuable for car manufacturers to lease electric cars, and for the publishers to rent books.

4 - Stocking More vs. Less: The Roles of Demand Volatility and Profit Margin under Market Valuation

Guoming Lai, University of Texas at Austin, 2110 Speedway, Austin, 78712, United States of America, guoming.lai@mccombs.utexas.edu, Wenqiang Xiao

We study the effects of asymmetric information of demand volatility on the inventory decision of a public firm who cares about not only its operational profits but also its market value. We find that the firm, when it faces a high demand volatility (less efficient), overstocks if the profit margin is low and understocks if the profit margin is high, while the firm with a low demand volatility (more efficient) may either overstock or understock in both cases.

■ TC43

Level 1 -101C

Issues in Service and Supply Chain Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Achal Bassamboo, Northwestern University, Kellogg School of Management, Evanston, IL, United States of America, a-bassamboo@kellogg.northwestern.edu

1 - Collaboration in Networks: Architectures, Bottlenecks and Throughput

Itai Gurvich, Associate Professor, Northwestern University, 2001 Sheridan Road, Evanston, IL, United States of America, i-gurvich@kellogg.northwestern.edu

We study networks where some activities require the simultaneous collaboration of multiple human resources. Collaboration requirements are not captured in the standard procedure to identify bottlenecks and theoretical capacity. We introduce the notions of collaboration architecture and unavoidable idleness and identify a special class of collaboration architectures that have no unavoidable idleness. We show that collaboration introduces subtleties also to questions of flexibility investment.

2 - Information Sharing in Supply Chains: An Empirical and Theoretical Valuation

Ruomeng Cui, Northwestern University, 2001 Sheridan Road, Evanston, United States of America, r-cui@kellogg.northwestern.edu, Achal Bassamboo, Jan Van Mieghem, Gad Allon

We provide an empirical and theoretical assessment of the value of sharing downstream information. According to recent work, the upstream forecast accuracy improvement is zero under a large set of parameters. We use the data from a CPG company to show the opposite result. Out theoretical model allows the decision maker to deviate away from a given inventory policy. These "decision deviations" turn out to lead to information losses, resulting in strictly positive value of downstream information.

3 - Assortment Competition and Supply Chain Responsiveness

Victor Martìnez de Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu, Gurhan Kok

In industries where customer needs quickly change, retailers can postpone their assortment decisions (amount of variety, balance across categories) if they are quick enough. We study here how assortment competition depends on the postponement capabilities of retailers.

4 - The Impact of Sustainability Efforts on Firm Financial Performance

Pei-Ju Wu, Northwestern University, Kellogg School of Management, Evanston, IL, 60208, United States of America, pei.ju-wu@kellogg.northwestern.edu, Sunil Chopra

Firms that invest in sustainability perform significantly worse than firms that do not over the first three years. Eco-collaboration (firms that collaborate do better than those that do not relative to the control group), eco-certification (do better), firm size (larger do better), eco-awards (do worse), and entering margin (high margin do worse) are important moderating factors.

■ TC44

Level 1 -101D

Models with Customer Choice

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Tim Huh, Associate Professor, University of British Columbia, Sauder School of Business, Vancouver, BC, V6T 1Z2, Canada, tim.huh@sauder.ubc.ca

Co-Chair: Hongmin Li, Arizona State University, W.P. Carey School of Business, Tempe, United States of America, Hongmin.Li@asu.edu

1 - Approximation Methods for Pricing under Nested the Logit Model

W. Zachary Rayfield, Cornell University, Ithaca, NY, United States of America, wzr2@cornell.edu, Paat Rusmevichientong, Huseyin Topaloglu

We present approximation methods for pricing problems under the nested logit model. Our methods obtain solutions with an approximation guarantee of (1+\delta) with computational work growing at rate 1 / \delta.

2 - An FPTAS for Capacitated Assortment Optimization Problem

Antoine Desir, Graduate Student, Columbia University, 500W 120th St., New York, United States of America, ad2918@columbia.edu, Vineet Goyal

We consider the capacitated assortment optimization problem where each product has a given weight and there is a capacity constraint on the assortment. We present a fully polynomial time approximation scheme (FPTAS) for the capacitated assortment problem for a large family of choice models including the MNL model, Nested logit model, and the mixture of constant number of MNL models. We also show that the capacitated assortment optimization is NP-hard even for the special case ofMNL model.

3 - Effects of Competition on PBM Profitability in Drug Distribution: Rebates and Price Spreads

Yixuan Xiao, Washington University in St. Louis, One Brookings Drive, Campus Box 1133, St. Louis, MO, 63130, United States of America, xiaoy@wustl.edu, Panos Kouvelis, Nan Yang

We model the competition among Pharmacy Benefit Managers (PBMs) for the patronage of a client organization. Each PBM determines prices to be charged to the client for branded and generic drugs (price decision) and assigns branded drugs to preferred or non-preferred formulary tiers (formulary decision). Drug manufacturers offer rebates to PBMs for drugs on preferred tier. We show the existence of a pure Nash equilibrium on prices and formulary decisions, and study the impact of model primitives.

4 - Pricing under the Nested Attraction Model with a Multi-stage Choice Structure

Hongmin Li, Arizona State University, W.P. Carey School of Business, Tempe, United States of America, Hongmin.Li@asu.edu, Tim Huh

We develop a solution approach to the centralized pricing problem of a nested attraction model with a multi-stage nested tree structure. We reduce the problem to an optimization of a single variable and characterize conditions under which the optimal solution can be uniquely determined. In the case for the multi-stage nested logit model, we show the impact of asymmetry in price sensitivity and adjustment index and we derive a closed-form solution when the tree structure is symmetric.

■ TC45

Level 1 -101E

Appointment Scheduling Under Patient Preferences

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Nan Liu, Assistant Professor, Columbia University, New York, NY, 10032, United States of America, nl2320@columbia.edu

1 - Capacity Allocation between Appointments and Walk-ins with Endogenous Patient Choice

Aditya Jain, Indian School of Business, AC 4, 4117, ISB Campus, Hyderabad, India, Aditya_Jain@isb.edu, Sarang Deo

We consider a healthcare system, wherein each patient decides the mode of arrival (appointment vs. walk-in) depending on the resulting waiting times (indirect vs. direct) as well as the severity of patient's condition. The healthcare provider decides the allocation of capacity between walk-in and appointment slots. We analyze the equilibrium of this game and derive managerial insights about the impact of patient characteristics on capacity allocation decisions.

2 - Appointment Policies with Patient Preferences

Yu Zhang, University of South Florida, 4202 E Fowler Ave., Tampa, FL, United States of America, yuzhang@usf.edu, Vidyadhar Kulkarni

We consider an appointment system where the patients have preferences about the appointment days. A patient may be scheduled on one of the days that is acceptable to her, or be denied appointment. The patient may or may not show up on the appointed time. The cost is a convex function of the actual number of patients served on a given day. We present structural properties of the appointment policy, and study a heuristic policy that is easy to implement and performs well.

3 - Capacity Management for Online Appointment Scheduling

Bo Zhang, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10598, United States of America, zhangbo@us.ibm.com, Nan Liu, Peter van de Ven

Consider an electronic patient appointment booking system for making online reservations. The system displays a set of available time slots and the patient selects an acceptable slot or leaves if none are acceptable. We propose blocking popular slots during initial stages, 'forcing' early patients to select less popular ones and increasing long-term utilization. We study the tradeoff between losing early patients (blocking too long) and having little flexibility later on (blocking too little).

■ TC46

Level 1 -101F

Supply Chain Management with Tax and Financial Planning

Sponsor: Manufacturing & Service Operations Management/iFORM

Sponsored Session

Chair: Ehsan Bolandifar, The Chinese University of Hong Kong, Shatin, NT, Hong Kong, Hong Kong, Hong Kong - PRC, ehsan@baf.cuhk.edu.hk

1 - Integrative Management of Transfer Pricing and Global Sourcing Decisions in a Multinational Firm

Vernon Hsu, Professor, The Chinese University of Hong Kong, CUHK Business School, Shatin, Hong Kong - PRC, vhsu@cuhk.edu.hk, Kaijie Zhu, Xiaopeng Zhang

We exam integrative management of a multinational firm's transfer pricing (TP) and global sourcing decisions to take advantage of different tax rates across subsidiaries and to maximize the firm's global after-tax profits. With various decision timelines (ex-ante and ex-post TP decisions) and structures (centralized and decentralized sourcing decisions), we characterize optimal TP and sourcing decisions in various scenarios. Several new and important managerial insights are derived.

2 - Managing Inventory for Entrepreneurial Firms with Trade Credits and Payment Defaults

Wei Luo, IESE Business School, Avenida Pearson, 21, Barcelona, Spain, wluo@iese.edu, Kevin Shang

We consider a credit-constrained firm that orders inventory to satisfy stochastic demand in a finite horizon. The firm provides trade credit to customers and receive it from the supplier. The work sheds light on the management of cash conversion cycle and demonstrates how liquidity provision can mitigate the bullwhip effect.

3 - Tax-Efficient Distribution Strategy for Multinational Firms

Maria Shunko, Purdue University, West Lafayette, IN, jUnited States of America, mshunko@purdue.edu, Andy Tsay

Risk sharing among members of a firm or a supply chain is known to be an effective coordination strategy. Tax rules link risk allocation to profit allocation, which in turn determines the taxes paid by multinational firms (MNF). E.g. a distributor that bears high risk should absorb high portion of profit; however, if this party is located in a high-tax jurisdiction, the benefit of risk sharing may be offset by the high tax bill. We model this tradeoff and find the optimal strategy for such MNFs.

4 - Transferring and Hedging Foreign Exchange Risk in a Global Supply Chain

Kun Soo Park, Assistant Professor, Korea Advanced Institute of Science and Technology, 85 Hoegiro, Dongdaemun-gu, Seoul, Korea, Republic of, kunsoo@kaist.ac.kr, Kyoung-Kuk Kim

We analyzes risk management contracts used to handle foreign exchange risk in a decentralized supply chain of a multinational firm. Particular contracts of interest are transferring risk to a third party by using currency options contracts and re-arranging risk between supply chain members using risk-sharing contracts. We study if and when these risk management contracts be be beneficial to each division and the total supply chain.

■ TC47

Level 1 -101G

Performance Evaluation and Improved Control for Service Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Opher Baron, University of Toronto, 105 St. George St., Toronto, ON, M5S3E6, Canada, Opher.Baron@Rotman.Utoronto.Ca

1 - Operations vs. Marketing Strategy: Considering Quality and Capacity Decisions in Customer Equity

Azin Farzan, The University of Washington, The Michael G. Foster School of Business, The University of Washington, Seattle, WA, 98195, United States of America, afarzan@uw.edu, Yong-Pin Zhou

We analyze the optimal decision set for a service provider. The firm chooses both capacity and quality levels and also the marketing strategy and investment level. Because the nature of the consumer behavior is heavily dependent on both the operations and marketing strategy, there is a natural tradeoff between these strategies. We model the effects of operations and marketing decisions on both the customer acquisition and retention processes and create an elaborate model of customer equity.

2 - Clinical Trials and New Drug Development: Optimal Investment Policies and Application

Joseph Milner, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, milner@rotman.utoronto.ca, Panos Kouvelis, Zhili Tian

Pharmaceutical firms enroll hundreds of patients in Phase III clinical studies at considerable cost in order to prove the safety, efficacy, and tolerability of new drugs. Delays in this process can significantly reduce the lifetime profitability of a drug. We model the enrolment process to establish optimal policies. We consider cases with and without interim analyses. We establish structural results and provide numerical results based on data.

3 - Strategic Idling in a Job-shop Queueing Healthcare Network - Analysis and Justification

Jianfu (Jeff) Wang, University of Toronto, Toronto, ON, Canada, Jianfu.Wang08@Rotman.Utoronto.ca, Oded Berman, Opher Baron, Dmitry Krass

In this study, we helped a company with a jobshop network to improve customers' service experience. The company has two major service level measures (SLM): 1) the total system time and 2) the probability of waiting more than 20 minutes for any stations. These two SLMs contradict each other: non-idle policies are intuitively good for SLM1, while the data shows that the company often idles servers for SLM2. Using simulation, we showed that idling policies can reduce SLM2 but not damage SLM1 much.

4 - Queue Decomposition and its Applications in State-dependent Queues

Hossein Abouee Mehrizi, University of Waterloo, 200 University Avenue West, Waterloo, ON, Canada, habouee mehrizi@uwaterloo.ca, Opher Baron

A main idea in the analysis of Markovian queueing systems is that at each point in time the system can be decomposed into two systems: in one system there are n or less people and in the other one there are n+1 or more people. We consider an M_n/G_n/1 state-dependent single server queue and show that our state-dependent queueing system is equivalent to a Markovian birth-and-death process. We discuss several service and inventory problems that can be modeled as a state-dependent queueing system.

■ TC48

Level 1 -101H

Fairness, Herding, and Cultural Issues in Operations Environments

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Karen Donohue, University of Minnesota, Twin Cities, 321 19th Avenue South, Minneapolis, MN, United States of America, donoh008@umn.edu

1 - Fairness in Dual Channel

Duygu Dagli, PhD Student, University of Texas at Dallas, Naveen Jindal School of Management, 800 West Campbell Road, Richardson, TX, 75080, United States of America, dxd115020@utdallas.edu, Ozalp Ozer

Direct channels provide higher profit margins for manufacturers at the expense of channel conflict. This study focuses on the price competition between a manufacturer-owned direct channel and a retailer channel under asymmetric power structure. We determine when behavioral regularities, in particular fairness, play a key role in pricing strategies and conflict resolution.

2 - Inventory Ordering Decisions in a Single Echelon: The Effect of Backorders

Jaime Andrés Castañeda, Universita della Svizzera Italiana (USI, Lugano), Via Giuseppe Buffi 13, Lugano, 6904, Switzerland, castanej@usi.ch

Behavioral work studying ordering decisions in single echelons has focused mainly on the classic Newsvendor problem in which excess demand is lost. In a lab experiment, I test a Newsvendor extension to the case of backorders and compare it to the traditional Newsvendor problem. Main results show that although people continue to underweight backorders in a simple inventory system, they do realize the benefits of an inventory system with backorders, especially for a low-safety stock product.

3 - Success and Failure of Continuous Process Improvement Teams in the Same Organization

Ken Schultz, Associate Professor, Air Force Institute of Technology, 2950 Hobson Way, WPAFB, 45433, United States of America, Kenneth.Schultz@afit.edu, Robert Rabon, Alan Johnson

We look at some less tangible facets of organizational culture that lead to successful Continuous Process Improvement. We used structured interviews and supervisor rankings of success to evaluate a conceptual model proposed by Lander and Liker (2007).

4 - Herding in a Queue: A Laboratory Experiment

Mirko Kremer, Assistant Professor, Pennsylvania State University, Business Building, University Park, PA, 16802, United States of America, muk22@smeal.psu.edu, Laurens Debo

We report results from a set of laboratory experiments designed to understand the impact of waiting time on human purchasing behavior when the quality of the product for which the human has to wait is uncertain. We confirm that the purchasing frequency may increase in the waiting time, i.e. human subjects 'herd'.

■ TC49

Level 1 -101I

Simulation Optimization: A Concise Overview and Implementation Guide

Cluster: Tutorials

Invited Session

Chair: Raghu Pasupathy, Associate Professor, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, pasupath@vt.edu

1 - Simulation Optimization: A Concise Overview and Implementation Guide

Raghu Pasupathy, Associate Professor, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, pasupath@vt.edu, Soumyadip Ghosh

Simulation optimization (SO) is the problem of optimization in the presence of objective and constraint functions that can only be observed via a simulation. This tutorial is a concise guide to a few key SO flavors. Our intended audience is a sophisticated practitioner looking for algorithmic implementations, or a researcher looking to be gently initiated into the vast SO literature. Accordingly, our discussion will be kept at a very accessible level, without omitting key details.

■ TC50

Level 1 -101J

Energy V: Power Generation and Distribution under Uncertainty

Contributed Session

Chair: Cong Liu, Computational Engineer, Argonne National Lab, Decision and Information Sciences Div., 9700 S Cass Avenue, Lemont, IL, 60439, United States of America, liuc@anl.gov

1 - Optimal Generation Mix in Japan under Uncertainty of Restart of Nuclear Power Plants

Misao Endo, Research Scientist, Central Research Institute of Electric Power Industry(CRIEPI), 1-6-1 Otemachi, Chiyoda-ku, Tokyo 100-8, Tokyo, Japan, endo@criepi.denken.or.jp, Yuzuru Nonaka, Shunsuke Nonaka, Yasuhiko Tabaru

After the Great East Japan Earthquake and accident at Fukushima-Daiichi nuclear plant, almost all nuclear plants have been shut down in Japan. Under uncertainty of restart of nuclear plants, we applied portfolio theory to analyze optimal generation mixes for Japan. The efficient frontier is constructed with considering Japan's technical constraints such as existing generating plants, load duration curve, introduction of renewables, and scenarios of nuclear power restart.

2 - A Stochastic Programming Approach to Power Dispatch with Renewable Energy Sources

Yu Zhang, University of Minnesota, 117 Pleasant St. SE, Room 450, Minneapolis, MN, 55455, United States of America, zhan1220@umn.edu, Nikolaos Gatsis, Georgios B. Giannakis

Leveraging stochastic programming techniques, robust and risk-limiting energy management problems are formulated to address the challenges associated with the intrinsically stochastic availability of renewable energy sources. Distributed economic dispatch minimizing the worst-case transaction cost for a microgrid is considered first. Subsequently, a novel scenario approximation solver is pursued for a chance-constrained optimization problem formulated to limit the risk of loss-of-load event.

3 - Efficient Heuristic Approaches in Power System Expansion Planning under Uncertainty

Fernanda Thome, PSR, Praia de Botafogo 228, 1701-A Botafogo, Rio de Janeiro, RJ, 22250145, Brazil, fernanda@psr-inc.com, Nora Campodonico, Silvio Binato, Mario Pereira

Methodology is described for this problem, considering decomposition and stochastic optimization approach. Combinatorial nature and uncertainties representation make the MILSP model a hard problem to solve, often suffering from very slow convergence or even failing to be properly solved. Strategic heuristics are proposed in this work and case studies show great improvement in the solution method efficiency, producing much better expansion results with significantly reduced computational effort.

4 - Scenario Generation and Reduction for Stochastic Unit Commitment with Wind Energy Penetration

Yonghan Feng, Iowa State University, Black Hall, Ames, United States of America, yhfeng@iastate.edu, Sarah Ryan

Uncertain load demand and wind energy are considered for day-ahead unit commitment. A two-stage stochastic program minimizing total expected cost is formulated, where commitment of thermal units are viewed as first-stage decisions. Scenario paths of hourly loads are generated according to a weather forecast based load model. Wind energy scenarios come from similar weather condition days. A new heuristic scenario reduction method is customized to alleviate the computational burden.

5 - Two-stage Robust Minimum Loss Distribution Network Reconfiguration Problem

Cong Liu, Computational Engineer, Argonne National Lab, Decision and Information Sciences Div., 9700 S Cass Avenue, Lemont, IL, 60439, United States of America, liuc@anl.gov, Changhyeok Lee

Adding renewable distributed generation such as solar panel can increase the uncertainty of the net demand in the electric power distribution network. We propose a two-stage robust optimization model for the minimum loss distribution network reconfiguration problem with load and distributed generation uncertainty. Computational results for a small test case are reported.

■ TC51

Level 1 -102D

Transit System Modeling I: Scheduling

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Leena Suhl, Professor, University of Paderborn, Warburger Str. 100, Paderborn, 33098, Germany, suhl@upb.de

1 - Social Equity and the Transit Scheduling Problem

Rohan Shah, Grad. Research Asst., The University of Texas at Austin, 301 E Dean Keeton Stop C1761, Austin, TX, 78712, United States of America, rohanshah@utexas.edu, Jennifer C. Duthie, Stephen Boyles, Randy B. Machemehl

The talk introduces the TSPEq, a multi-step methodology to attempt the traditional transit scheduling problem (TSP), but with additional factors addressing social inequity and inaccessibility issues for disadvantaged or under-served populations. It aims to provide equitable transit access for all sections of the society, while facilitating inclusion in transit planning models.

2 - Demand Clustering in Logistics Networks

Rodrigo Mesa-Arango, Purdue University, West Lafayette, IN, United States of America, rmesaara@purdue.edu, Satish Ukkusuri

Clustering freight demand in logistics networks is important to determine groups of lanes that are attractive for a carrier given its current operations, costs, and the level of synergy between the lanes. This research proposes concepts to build such logistics networks and applies a network clustering algorithm to determine the sets of lanes that are more likely to be served together in order to maximize the expected profits of the carrier. Numerical experiments show the benefits of this approach.

3 - Multiple Scenario Approaches for Pick-up and Delivery Problems with Time Windows

Niels Agatz, Rotterdam School of Management, Erasmus University, Rotterdam, Netherlands, nagatz@rsm.nl, Jordan Srour

Due to the asymmetric nature of distances in the pick-up and delivery problem, previous versions of Multiple Scenario Analysis (MSA), which focused on the vehicle routing problem, require adaptation. This presentation demonstrates the capabilities of an MSA strategy that has been tailored to the pick-up and delivery problem with time windows. We provide numerical results based on several instances.

■ TC52

Level 1 -102E

Innovative Applications of Routing Problems II

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Karthik Charan Konduri, Assistant Professor, University of Connecticut, 261 Glenbrook Road, Unit 3037, Storrs, CT, 06269, United States of America, kkonduri@engr.uconn.edu

1 - Solving Multi-trip Vehicle Routing under Order Incompatibilities – A RVRP Arising in SCM

Ulrich Derigs, Professor, University of Cologne, Albertus Magnus Platz, Koeln, Germany, ulrich.derigs@uni-koeln.de, Markus Pullmann

We introduce a new VRP class which is motivated by a specific 2-echelon distribution system where products come to the depot from different factories by semi-trailers and the trailers are also used for short-haul distribution with other trucks, i.e. the load from different factories is not consolidated at the depots. We model the problem as a set partitioning problem and show that concurrent LS/LNS- neighborhood search is effective and efficient.

2 - Election Day Routing of Rapid Response Attorneys

Justin Goodson, Saint Louis University, 3674 Lindell Blvd., St. Louis, MO, 63128, United States of America, goodson@slu.edu

Since the US presidential election of 2000, political campaigns have deployed volunteer lawyers to provide real-time information and assistance to poll observers. To assist with the routing of these rapid response attorneys (RRAs) among polling locations, we design annealing-based heuristics to equitably and efficiently allocate volunteer resources. We describe how our efforts to route RRAs in one state benefited election day operations during the 2012 election.

3 - Technician Routing with Learning

Xi Chen, University of Iowa, S321 John Pappajohn Business Building, The University of Iowa, Iowa City, IA, 52242, United States of America, xi-chen-3@uiowa.edu, Mike Hewitt, Barrett Thomas

We introduce the technician routing problem with experience-based learning. We present a solution method assigns jobs to technicians over the planning horizon thus directing learning. We compare the approach to a daily decomposition. Computational experiments demonstrate the value of incorporating learning and the effectiveness of the approach.

4 - Daily Routing for Customer Relationships in the Textbook Industry

Shu Zhang, University of Iowa, Tippie College of Business, S321 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, shu-zhang-1@uiowa.edu, Jeffrey Ohlmann, Barrett Thomas

We study an orienteering problem with stochastic wait times motivated by the daily decision making faced by textbook sales representatives. We explore structural properties of solutions and specifically investigate the existence of a control limit policy to govern the balk or join decision upon arrival at a queue outside a professor's office. We focus on developing an approximate dynamic programming scheme to obtain dynamic routing solutions to maximize the expected textbook sales.

■ TC53

Level 1 -102F

Advances in Vehicle Routing Problems II

Contributed Session

Chair: Bimal Nepal, Assistant Professor, Texas A&M University, 3367 TAMU, College Station, TX, 77845, United States of America, nepal@entc.tamu.edu

1 - Path Relinking and GRASP-ASP for a Bi-objective VRP

Arne Løkketangen, Professor, Molde University College, Brtveien 2, Molde, 6411, Norway, arne.loketangen@himolde.no, Jorge Oyola

We look at the bi-objective CVRP-RB. This is the standard CVRP with an additional route balancing objective, a fairly common real-world variant. We approximate the efficient frontier heuristically with PR, Path Relinking, and with GRASP-ASP, GRASP-Advanced Starting Position, a variant of standard GRASP. The results on standard test-cases from the literature are compared with results from, GUROBI .

2 - Solving the Robust Vehicle Routing Problem under Demand Uncertainty

Chrysanthos E. Gounaris, Princeton University, A425 E-Quad, Princeton, NJ, 08544, United States of America, gounaris@princeton.edu, Panagiotis P. Repoussis, Wolfram Wiesemann, Christos D. Tarantilis, Christodoulos A Floudas

This presentation considers the Capacitated Vehicle Routing Problem under polyhedral uncertainty in the customer demands. We present exact robust formulations that do not exhibit any over-conservatism beyond the specification of the uncertainty set, and develop a branch-and-cut procedure that can solve small- and medium-sized instances to guaranteed optimality. We further propose an Adaptive Memory Programming metaheuristic to address larger-scale instances.

3 - Vehicle Routing Optimization Problem Considering Hard Time Window, Rush Orders, and Stochastic Travel

Bimal Nepal, Assistant Professor, Texas A&M University, 3367 TAMU, College Station, TX, 77845, United States of America, nepal@entc.tamu.edu, Akshay Bartakke

A single depot multiple vehicles routing optimization problem is presented with hard time window, back haul, rush orders, and stochastic travel time. The cost of accommodating rush orders is a tradeoff between the re-routing of a loaded truck and dispatching a separate truck for that assignment. Cplex/Ampl and Simulated Annealing (SA) Algorithm have been applied to solve the problem for several instances and the quality of solution has been compared.

4 - The SUCIM Algorithm: An Efficient Method to Optimize the Throughput of a Manufacturing Line

Alejandro García del Valle, Full Professor, University of A Coruna, Mendizabal s/n, Ferrol A 15403, Spain, agvalle@udc.es, Diego Crespo Pereira, Javier Faulin, Adolfo Lamas Rodriguez

We propose a new method to optimize the throughput of a manufacturing line by task balancing. SUCIM balances the line in both ways: downstream and upstream, balancing subsets of stations in each iteration. The method has been tested solving a big number of instances. The results demonstrate the robustness of the method, achieving efficiency values near optimal in all instances, with relatively low calculation times. The method has been programmed and implemented in JAVA.

■ TC54

Level 1 -103A

Market-based Instruments for Congestion Mitigation: III

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Yu Nie, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60608, United States of America, y-nie@northwestern.edu

1 - Piecewise Linear Approximation of Bi-level Problems in Transportation

Ximing Wang, University of Florida, Industrial and Systems Engineering, 303 Weil Hall, Gainesville, FL, 32611, United States of America, X.Wang@ufl.edu, Siriphong Lawphongpanich, Yafeng Yin

This talk proposes a piecewise linear approximation scheme for solving bi-level problems in transportation. The scheme allows a bi-level problem to be solved approximately as a linear integer program. The approximate solution can be further refined by adding additional linear pieces and solving the expanded linear integer program starting from a previous solution.

2 - Congestion and Emission Mitigation on Signalized Networks

Yuqi Sun, Industrial and Manufacturing system Engineering, the Pennsylvania State University, 240 Leonhard, University Park, United States of America, yus139@psu.edu, Terry Friesz, Hongcheng Liu, Tao Yao, Ke Han

We seek an optimal fixed-cycle, dynamic-split signal control strategy on a road network. The goal is to reduce both congestion and vehicle emission, assuming travelers behave selfishly. The on-and-off signal timing is replaced with a time-dependent parameter imposed on each junction. An emission model that incorporates both vehicle acceleration/deceleration and the Gaussian dispersion function is proposed. The problem of optimal signal strategy is solved as a bi-objective MPEC.

3 - Sensor Location Problems for Path-differentiated Congestion Pricing

Mahmood Zangui, University of Florida, 365 Weil Hall, Gainesville, FL. United States of America, mzangui@ufl.edu, Yafeng Yin, Siriphong Lawphongpanich

Path-differentiated congestion pricing is a pricing scheme where tolls are imposed on paths instead of individual links. To implement the scheme, sensors such as toll tag readers are installed to collect the location information of vehicles in order to charge them accordingly. In this talk, we investigate the problems of finding optimal sensor locations to implement path-differentiated pricing to minimize system travel time and optimize another secondary objective.

4 - More Equitable Congestion Pricing and Tradable Credit Scheme for Managing Rush Hour Travel Choices

Mohammad Miralinaghi, Research Assistant, Purdue University, 2156 tortuga ln, West Lafayette, IN, 47906, United States of America, smiralin@purdue.edu, Srinivas Peeta, Satish Ukkusuri

Equity is an important factor to promote congestion pricing and tradable credit schemes. Motivated by this objective, we investigate a comprehensive approach to obtain an optimal pricing toll scheme for congestion pricing and tradable credits in the single bottleneck model with general user heterogeneity in a discrete time setting.

■ TC55

Level 1 -103B

Shift Scheduling

Contributed Session

Chair: Bin Li, University of Arkansas, 4110 Bell Engineering Center, University of Arkansas, Fayetteville, AR, 72701, United States of America, binli@email.uark.edu

1 - Nurse Scheduling: A 24-7 Cycle Application

Ozay Ozaydin, Dogus University, Zeamet S. No:21 Acibadem, Istanbul, 34722, Turkey, oozaydin@dogus.edu.tr

In this study, scheduling problem of nurses to hospital stations is investigated. Effective utilization of work forces with respect to work loads create certain bottlenecks and infeasible solutions. The proposed algorithm starts by determining optimum number of nurses to be assigned, followed by branching for certain needs of the hospital administration. The model is then utilized for a chain of hospitals in Istanbul.

2 - A Flexible Iterative Improvement Heuristic to Create Feasible Shift Rosters in Self-Rostering

Marco Schutten, University of Twente, School of Management and Governance, PO Box 217, Enschede, 7500 AE, Netherlands, m.schutten@utwente.nl, Egbert Van der Veen, Johann Hurink, Suzanne Uijland

In self-rostering, employees propose their own schedules. Since these schedules often do not match with staffing demand, we present an approach to support creating feasible schedules, using the proposed schedules as input. The approach aims to divide the burden of shift reassignments 'fairly' among the employees and allows to balance transparency of shift reassignments and the quality of the final roster. We discuss computational results and indicate how various model parameters influence KPIs.

3 - A Two-stage Approach to Solve Multi-department Shift Scheduling Problems

Sana Dahmen, Ph.D. Student, Laval University, CIRRELT, 2846, Gabriel Le Prévost, Appart 5, Québec, G1V1Z7, Canada, Sana Dahmen, Ph.D. Student, Laval University, CIRRELT, 2325, rue de la Terrasse, Université Laval, Québec G1V1Z7, Canada, sana.dahmen@cirrelt.ca

We present a two-stage approach to solve shift scheduling problems in multi-department context. The first stage is based on column generation technique. It aggregates the problem to identify a good transfer scheme between departments. The second stage is based in a decomposition framework yielding to particular sub-graphs without cycles. It uses the transfer scheme to construct daily schedules. The approach is tested on random generated scenarios inspired by real-life problems.

4 - Scheduling Workers in a Warehouse Based on Productivity Performance

Bin Li, University of Arkansas, 4110 Bell Engineering Center, University of Arkansas, Fayetteville, AR, 72701, United States of America, binli@email.uark.edu, Ashlea Bennett Milburn

We consider a scheduling problem where a set of tasks must be assigned to workers based on the task productivities. The objective is to minimize the total work hours required to perform all tasks. Constraints related to ready times, deadlines and worker duty times must be satisfied. We model this as a parallel machine scheduling problem with unrelated machines. Optimized results are presented and a strategy for integrating the solution mechanism with the labor management system is discussed.

■ TC56

Level 1 -103C

Optimization Methods in Smart Grid

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47906, United States of America, andrewliu@purdue.edu

1 - Flexible Demand Management in the Smart Grid: Robust Solutions

Yong Liang, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, United States of America, yongliang@berkeley.edu, Z. Max Shen

We study the flexible demand management problem with stochastic prices and demand arrivals. Decisions are made recursively over a certain number of periods. We first analyze the stochastic multi-objective optimization problem where the objectives are to minimize the expected total cost and discomfort. Then, we formulate and solve a distributional-robust optimization model. We show that decision makers will be potentially better off if confronted with stochastic prices.

2 - Energy Management of Interconnected Price-Responsive Demands

Antonio Conejo, University of Castilla-La Mancha, Department of Electrical Engineering, Campus Universitario, Ciudad Real, 13071, Spain, Antonio.Conejo@uclm.es, Morteza Rahimiyan, Luis Baringo

We consider a cluster of price-responsive demands. An energy management system coordinates these demands and provides the interface for energy trading between the demands and the suppliers: a renewable source and the main grid. We propose a smart grid robust optimization algorithm that results in maximum expected utility for the demands. The uncertainty of both the production level of the renewable source and the energy price from the main grid is modeled using robust sets.

3 - Implementing Real-time Pricing in Wholesale Electricity Markets

Jingjie Xiao, Purdue, Grant St., Apt. 16, West Lafayette, IN, 47906-3682, United States of America, jingjie.xiao@gmail.com, Andrew Liu

A key hurdle for implementing real-time pricing of electricity is the lack of consumers' response. Solutions include energy management systems that can automatically optimize household appliance usage such as EV/PEV charge (and discharge with V2G) via two-way communication with the grid. This talk will present how real-time retail pricing, aided by control automation devices, can be integrated into wholesale electricity markets under various uncertainties through approximate dynamic programming.

4 - Optimization of Wind, Diesel and Battery Systems for Remote Areas

Miguel F. Anjos, Canada Research Chair, Ecole Polytechnique de Montreal, C.P. 6079, Succ. Centre-Ville, Montreal, QC, H3C 3A7, Canada, miguel-f.anjos@polymtl.ca, Thibault Barbier, Gilles Savard

Hybrid energy systems are often designed using simulation-based tools in which the dispatch rules are set a priori by the decision-makers. This choice of rule influences the results obtained and may be sub-optimal. We present an integer linear optimization model for the problem of finding the optimal design and dispatch scenario without using dispatch rules. The corresponding implementable rules are then extracted from these results.

■ TC57

Level 1 -103D

Optimizing EV Charging and Investment in Generation Capacity and CCS

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Erica Plambeck, Professor, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, Plambeck_Erica@GSB.Stanford.Edu

1 - Joint Planning of Energy Storage and Transmission for Wind Energy Generation

Wei Qi, University of California, Berkeley, Berkeley, CA, 94720, United States of America, qiwei@berkeley.edu, Yong Liang, Z. Max Shen

Regions with abundant wind energy usually have no ready access to power infrastructure. We develop an approach to determining the sizes and sites of energy storage stations as well as the corresponding topology and capacity of the transmission network. A location-inventory model is formulated to solve for the energy storage-transmission network with uncapacitated storage. Then we incorporate storage sizing decisions by deriving conservative estimates of the expected energy overflow.

2 - Optimizing Controlled Electric Vehicle Charging to Reduce Costs of Electric Power Systems

Allison Weis, PhD Student, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, aeweis@andrew.cmu.edu, Paulina Jaramillo, Jeremy Michalek

We construct a MILP model of optimal power plant capacity expansion, dispatch, and plug-in vehicle charging to estimate the benefits of electric vehicle demand management using variable rate charging (less costly than bidirectional V2G). We estimate the implications for system cost, integration of intermittent wind power, wind curtailment avoided, and peaking plant construction avoided.

3 - Value of Vehicle-to-Grid Electricity under a 100% Renewable Energy System

Xiaoshan Peng, PhD Student, Booth School of Business, 5807 S Woodlawn Ave., Chicago, IL, 60637, United States of America, x-peng@chicagobooth.edu, Erica Plambeck, Baris Ata, Elaine Hart

The emerging plug-in electric vehicles (PEVs) have significant potential to support the penetrations of the renewable resources. We investigate the value of vehicle-to-grid (V2G) under a fossil-free system via a dynamic control model that incorporates the uncertainty of the wind and solar power to determine the optimal charge and discharge rates of the electric vehicles.

4 - Investments in Carbon Capture from Gas-fired Electricity Generation under Uncertainty

John Bistline, Stanford University, 475 Via Ortega, Stanford, CA, 94305, United States of America, bistline@stanford.edu, Anshuman Sahoo, Stefan Reichelstein, Stephen Comello

This research investigates how uncertainty will impact the deployment of carbon capture and storage (CCS) on gas-fired electricity generation. Using a real options approach, this work examines how uncertainties in natural gas price paths, climate policy stringency, cost of CCS-related technologies, and costs of competing zero-emission technologies will influence investment dynamics from the perspective of a firm specializing in merchant electricity generation.

■ TC58

Level 1 -103E

Mediating Risk with Financial Products in Electricity Markets

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Daniel Ralph, Professor of Operations Research, University of Cambridge, Judge Business School, Cambridge, United Kingdom, d.ralph@jbs.cam.ac.uk

1 - Introduction to Risk Trading in Energy Investments and Markets - Endogenous Uncertainty

Daniel Ralph, Professor of Operations Research, University of Cambridge, Judge Business School, Cambridge, United Kingdom, d.ralph@jbs.cam.ac.uk, Gauthier de Maere d'Aertrycke, Yves Smeers, Andreas Ehrenmann

Electricity generators face huge uncertainties, relating to carbon emissions, that were not on the horizon in the early days of deregulation in the USA. We survey recent progress in models of risky power plant investments as an equilibrium process, where power generation and sales take place in a stochastic environment; and agents are risk averse & use financial products to offset their risk. Coherent risk measures are powerful in linking risk aversion to standard risk neutral equilibrium models.

2 - CAPM and Risk Functions Equilibrium Models of Investment in Generation Capacities

Yves Smeers, Professor Emiritus, Universite' catholique de Louvain, Louvain-la-Neuve, Belgium, yves.smeers@uclouvain.be, Gauthier de Maere d'Aertrycke, Andreas Ehrenmann

We reformulate the standard capacity expansion model into a stochastic equilibrium model for which we consider different extensions. Working in a CAPM/APT context we consider differentiated discount rates, stochastic discount rates and differentiated stochastic discount rates. Working with risk functions we consider incomplete markets. All models have a common property in terms of oddity of the number of solutions.

3 - Endogenous Gas Contracts

Andreas Ehrenmann, Chief Analyst, GDF-Suez Research Energy, Brussels, Belgium, Andreas.Ehrenmann@gdfsuez.com, Ibrahim Abada, Yves Smeers

We present a stochastic gas market model to capture the optimal long term contract quantity signed between producer and midstreamer. The model is based on an equilibrium approach where each player strives to optimize his long term risk adjusted payoff. We assume the existence of a gas spot market where gas can be traded on the short term and the possibility to engage in LT contracts with different indexations. We discuss solution approaches and present first computational results.

4 - Stochastic-endogenous Generation Capacity Expansion Equilibrium: Incompleteness and Remedies

Gauthier de Maere d'Aertrycke, Research Analyst, GDF-Suez Energy, Brussels, Belgium, gdemaere@gmail.com, Yves Smeers, Andreas Ehrenmann

The European power industry is currently facing risks concerning climate policies and demand growth. Those risks are impossible to trade and markets alone might not be sufficient to deliver the appropriate investment. To restore the investment signal, forward contracts and reliability options were proposed in the literature. We elaborate on the issue using a stochastic-endogeneous equilibrium model and analyze how the mechanisms help to complete the market in terms of welfare and investment.

■ TC59

Level 1 -103F

Green Behavior and Environmental Sustainability

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Gwen Spencer, Nuekom Fellow, Dartmouth College, 19A Maple Street, Hanover, NH, 03755, United States of America, gwenspencer@gmail.com

1 - Designing Intervention Scheme for Public-Interest Goods under Random Supply

Ece Demirci, Ph.D. Student, Department of Industrial Engineering Bilkent University, Ankara, 06800, Turkey, edemirci@bilkent.edu.tr, Nesim Erkip

We study the problem of designing an intervention scheme for public-interest goods (health-related products, energy efficient appliances, etc.). We consider a system composed of a newsvendor firm that is subject to random supply and a central authority with fixed budget. The central authority regulates the system by two intervention tools: advertising, and research and development investments. We use bi-level programming for modeling the system and provide some structural properties.

2 - Marketing Green Behavior Change: Seeding Norm-driven Moral-Motivation in Social Networks

Gwen Spencer, Nuekom Fellow, Dartmouth College, 19A Maple Street, Hanover, NH, 03755, United States of America, gwenspencer@gmail.com

In public management and private life, decisions to adopt sustainable behaviors often carry personal costs. In turn, these behaviors contribute to environmental quality (a common good). Ecological economists suggest that individuals feel personal responsibility to adopt green behaviors when many others also "chip in." This motivates a model of how environmentally-friendly norms spread (and stabilize) in networks. Theoretical and computational results depart strongly from information spread.

3 - Electric Vehicle Selection Problem in City Logistics

Yavuz Gunalay, Bahcesehir University, Faculty of Economics and Admin Science, Istanbul, 34353, Turkey, yavuz.gunalay@bahcesehir.edu.tr, Levent Aksoy, Burak Kucuk

As the urbanization rate increases everyday, city logistics become more and more important. Electric vehicles are both environmentally friendly and also less costly alternative to internal combustion engine vehicles. However, decision methods employed by businesses are not useful to evaluate these systems. We propose a new model that helps businesses to evaluate the contribution of electric vehicles in city logistics.

4 - Optimization to Select Green Building Options

John F Dickson, University of Texas at Arlington, 2420 S. Fielder Rd., Arlington, TX, 76015, United States of America, john.dickson@mavs.uta.edu, Victoria C Chen, Jay Rosenberger, Anthony Robinson, Pin Kung

A mixed integer linear programming (MILP) model is presented to optimize green building design over multiple performance objectives. Performance objectives are predicted via treed regression models developed using design and analysis of computer experiments with eQUEST software as the computer experiment. Results of single story building case study were studied. Future study includes sequential design of experiments to minimize the computer runs and improve the optimization.

■ TC60

Mezzanine - 100A

Joint Session DM/HAS/AI: System Modeling and Health Informatics

Sponsor: Data Mining, Health Applications, & Artificial Intelligence

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 E Fowler Ave. ENB118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Probabilistic Graphical Modeling Based on L1 Penalized Likelihood for Cancer Gene Network

Sung Won Han, Research Scientist, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com, Hua Zhong, Gong Chen, Anton Belousov, Laurent Essioux

Directed acyclic graphic model has been suggested to model the interactions among random variables where directed edges represent the causal influence of components of the system. This presentation discusses the estimation of the structure of the directed acyclic graph by the L1-penalized likelihood approach. We formulate the problem by a linear structure with latent variables under the assumption that the variances of latent variables are unequal and unknown, and a natural ordering is unknown.

2 - Impacts of Information Transmission and Human Behaviors in Epidemics: A Spatial Game Model

Chih-Hang(John) Wu, Associate Professor, Kansas State University, 2037 Durland Hall, Manhattan, KS, 66506, United States of America, chw@ksu.edu, David Ben-Arieh, Songnian Zhao

Information transmission plays an essential role in the dynamics of infectious disease transmission since individuals decides their behaviors based on the current information. Two types of impacts from information transmission to the spread of epidemics, called local impact and global impact, and the corresponding stability analysis are studied in this paper.

3 - Modeling, Grouping, and Monitoring of Nonlinear and Spatiotemporal Profiles

Gang Liu, University of South Florida, 4202 E Fowler Ave., Tampa, FL, 33620, United States of America, gliu@mail.usf.edu, Hui Yang

Recently, we developed a multiscale basis function model to characterize the spatiotemporal signals from complex systems. In this paper, we develop a novel algorithm that clusters model parameters into minimally redundant groups. This addresses multi-collinear effects in the large sets of features extracted from model parameters. In addition, we develop a new group feature selection method that eliminates unimportant groups and selects the most informative features for performance monitoring.

4 - Data Mining Approach using Hemodynamic Parameters

Monica Puertas, University of South Florida, 18125 Birdwater Dr., Tampa, FL, 33647, United States of America, mpuertas@mail.usf.edu, Peter Fabri, Jose Luis Zayas-Castro

The accurate assessment of the circulatory system is important for critically ill patients. Often changes in circulatory status occur rapidly, requiring continuous monitoring. This study is focused on how to extend the usability of hemodynamic parameters such as cardiac output and systemic vascular resistance, using a data mining approach with available clinical metrics to produce individual predictive hemodynamic models.

■ TC61

Mezzanine - 100B

Data Mining in Health Applications

Sponsor: Data Mining

Sponsored Session

Chair: Chun-An (Joe) Chou, SUNY Binghamton, Binghamton, NY, 13902, United States of America, cachou@binghamton.edu

1 - Consensus Unsupervised Learning for Biomedical Networks

Petros Xanthopoulos, University of Central Florida, Orlando, FL, United States of America, petrosx@ucf.edu, Siavash Haghtal

Network clustering is an important task for many biomedical applications. Unfortunately clustering results may differ significantly for each algorithm. Many times locally optimal algorithms such as kmeans is possible to produce totally different results for different runs. In this works we propose a robust unsupervised learning framework for dealing with these inconsistencies. Our approach is compared with individual clustering algorithms as well as other ensemble unsupervised learning methods.

2 - A Network based Method to Identify Highly Discriminating Subsets of Biomarkers

Seyed Javad Sajjadi, University of South Florida, 4202 E Fowler Ave., ENC 2400, Tampa, FL, 33620, United States of America, ssajjadi@mail.usf.edu, Xiaoning Qian, Bo Zeng, Amin Ahmadi Adl

To identify highly predictive biomarkers, we integrate individual predictive power of risk factors with their interactions and formulate a new network-based optimization model to derive a collection of cliques with the maximum total weight. An analytical algorithm based on column generation method is developed to achieve optimal or near optimal solution. Experimental results show that our method can identify important biomarkers with better prediction accuracy.

3 - Multi-voxel Pattern Analysis of fMRI Data with Mutual-information Based Feature Selection

Fatma Gumus, PhD Student, SUNY Binghamton, Binghamton, NY, 13902, United States of America, fgumus1@binghamton.edu, Chun-An (Joe) Chou

Recent studies have pointed out that multi-voxel pattern analysis (MVPA) of fMRI data is a promising technique to explain the distributive working nature of the brain. However, the disparity between the number of features and available observations is made difficult to reach easy and meaningful results. In this work, mutual information based feature selection is applied to reduce scale of the problem. Experimental results for several classifiers are shown for different experimental settings.

■ TC62

Mezzanine - 100C

Data Fusion for Process Control

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Liu, Ph.D Candidate, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, United States of America, kbliu@gatech.edu

1 - within-cycle Monitoring and Diagnosis of Cyclic Nonlinear Profile Signals

Weihong Guo, PhD Candidate, University of Michigan, 1205 Beal Avenue, IOE Building, ANN ARBOR, MI, 48105, United States of America, graceguo@umich.edu, Judy Jin, S. Jack Hu

Existing research on cyclic profile monitoring is limited to between-cycle detection made for each finished part based on its entire cycle of signals. In manufacturing processes with critical part quality and high cost, however, process changes require detection before the part is produced so that within-cycle adjustments can be triggered. This research develops a monitoring and diagnosis methodology that is capable of making within-cycle decisions and guiding real-time process adjustments.

2 - Manifold Learning for Discovering Variation Patterns in Noncontact Dimensional Metrology Data

Daniel Apley, Northwestern University, Dept. Industrial Engineering, Evanston, IL, 60208-3119, United States of America, apley@northwestern.edu, George Runger, Edwin Shi

Imaging and laser optical dimensional metrology systems are becoming increasingly common in manufacturing quality control. Although fitting parametric geometric dimensioning and tolerancing features is well established, there has been little prior research on how to utilize the data to discover the nature of nonparametric part-to-part variation patterns that have not been pre-identified and pre-modeled. We propose the use of manifold learning techniques to extract and visualize such information.

3 - Data and Information Fusion for Bio-medical Design and Bio-manufacturing Processes

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This paper presents methods of data analysis and information fusion in bio-medical design and bio-manufacturing processes improvement. Technical methods of data and information fusion and the new industrial engineering role in bio-medical design and bio-manufacturing systems development are discussed in this paper. In overview, this research investigates a method for transforming uncontrolled biological procedures into reproducible, controlled manufacturing processes.

4 - An Adaptive Sampling Strategy for Online High-dimensional Process Monitoring with Limited Resources

Kaibo Liu, Ph.D Candidate, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, United States of America, kbliu@gatech.edu, Yajun Mei, Jianjun Shi

Temporally and spatially dense data-rich environments provide unprecedented opportunities and challenges for process control. This research proposes an adaptive sampling strategy with only limited resources available at each acquisition time for online high-dimensional process monitoring. A monitoring scheme of using the sum of top-r local detection statistics is developed. Case studies are performed on a hot forming and a real solar flare process.

■ TC63

Mezzanine - 100D

The Modeling, Monitoring and Control of Systems using Complex Data (II)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

Co-Chair: Fadel Megahed, Assistant Professor, Auburn University, 3301L Shelby Center, Auburn, AL, 36849, United States of America, fmegahed@auburn.edu

1 - A Change-point Approach for System Monitoring and Diagnosis using Multichannel Profiles

Kamran Paynabar, Georgia Institute of Technology, Atlanta, GA, United States of America, kamran.paynabar@isye.gatech.edu, Peihua Qiu, Changliang Zou

Process monitoring and fault diagnosis using multichannel profile data remain an important problem in SPC. Motivated by a real application, this research develops a new monitoring and diagnosis framework for phase-I analysis of multichannel profiles. The proposed framework incorporates multi-dimensional functional principal component analysis into change-point models. The proposed methodology is validated via simulation and a case study.

2 - Opportunistic Condition Based Maintenance using Equivalent Age Model

Ali Aldubaisi, PhD Student, Auburn University, 3301 Shelby Center, Auburn, AL, 36849, United States of America, aza0050@tigermail.auburn.edu, Fadel Megahed

Equivalent age models are very flexible since they do not require the life distributions to be shape invariant. However, they have only been proposed to model the aging rate of a single machine and the available literature on developing maintenance strategies based on equivalent age is preliminary. Thus, the objective of our work is to allow for multiple machine configurations with dependencies, while triggering maintenance based on multiobjective optimization routines and experimental results.

3 - Quality Monitoring of Manufacturing Processes by In-process Sensor Signals

Marco Grasso, Dipartimento di Meccanica - Politecnico di Milano, Via La Masa 1, Milan, Italy, marco.grasso@musp.it, Bianca Maria Colosimo

An increasing attention in manufacturing industry has been devoted to the use of in-process signals to improve quality, productivity and automation. The analysis of real-time data streams leads to different challenges for quality control. Thus, signal pre-processing, registration and fusion techniques are critical for the achievement of desired performances. The paper investigates new methods and open issues related to the application of SPC and profile monitoring techniques to sensor data.

3 - Endogenous Gas Contracts

Andreas Ehrenmann, Chief Analyst, GDF-Suez Research Energy, Brussels, Belgium, Andreas.Ehrenmann@gdfsuez.com, Ibrahim Abada, Yves Smeers

We present a stochastic gas market model to capture the optimal long term contract quantity signed between producer and midstreamer. The model is based on an equilibrium approach where each player strives to optimize his long term risk adjusted payoff. We assume the existence of a gas spot market where gas can be traded on the short term and the possibility to engage in LT contracts with different indexations. We discuss solution approaches and present first computational results.

4 - Stochastic-endogenous Generation Capacity Expansion Equilibrium: Incompleteness and Remedies

Gauthier de Maere d'Aertrycke, Research Analyst, GDF-Suez Energy, Brussels, Belgium, gdemaere@gmail.com, Yves Smeers, Andreas Ehrenmann

The European power industry is currently facing risks concerning climate policies and demand growth. Those risks are impossible to trade and markets alone might not be sufficient to deliver the appropriate investment. To restore the investment signal, forward contracts and reliability options were proposed in the literature. We elaborate on the issue using a stochastic-endogeneous equilibrium model and analyze how the mechanisms help to complete the market in terms of welfare and investment.

■ TC59

Level 1 -103F

Green Behavior and Environmental Sustainability

Sponsor: Energy, Natural Res & the Envi/ Environment and Sustainability

Sponsored Session

Chair: Gwen Spencer, Nuekom Fellow, Dartmouth College, 19A Maple Street, Hanover, NH, 03755, United States of America, gwenspencer@gmail.com

1 - Designing Intervention Scheme for Public-Interest Goods under Random Supply

Ece Demirci, Ph.D. Student, Department of Industrial Engineering Bilkent University, Ankara, 06800, Turkey, edemirci@bilkent.edu.tr, Nesim Erkip

We study the problem of designing an intervention scheme for public-interest goods (health-related products, energy efficient appliances, etc.). We consider a system composed of a newsvendor firm that is subject to random supply and a central authority with fixed budget. The central authority regulates the system by two intervention tools: advertising, and research and development investments. We use bi-level programming for modeling the system and provide some structural properties.

2 - Marketing Green Behavior Change: Seeding Norm-driven Moral-Motivation in Social Networks

Gwen Spencer, Nuekom Fellow, Dartmouth College, 19A Maple Street, Hanover, NH, 03755, United States of America, gwenspencer@gmail.com

In public management and private life, decisions to adopt sustainable behaviors often carry personal costs. In turn, these behaviors contribute to environmental quality (a common good). Ecological economists suggest that individuals feel personal responsibility to adopt green behaviors when many others also "chip in." This motivates a model of how environmentally-friendly norms spread (and stabilize) in networks. Theoretical and computational results depart strongly from information spread.

3 - Electric Vehicle Selection Problem in City Logistics

Yavuz Gunalay, Bahcesehir University, Faculty of Economics and Admin Science, Istanbul, 34353, Turkey, yavuz.gunalay@bahcesehir.edu.tr, Levent Aksoy, Burak Kucuk

As the urbanization rate increases everyday, city logistics become more and more important. Electric vehicles are both environmentally friendly and also less costly alternative to internal combustion engine vehicles. However, decision methods employed by businesses are not useful to evaluate these systems. We propose a new model that helps businesses to evaluate the contribution of electric vehicles in city logistics.

4 - Optimization to Select Green Building Options

John F Dickson, University of Texas at Arlington, 2420 S. Fielder Rd., Arlington, TX, 76015, United States of America, john.dickson@mavs.uta.edu, Victoria C Chen, Jay Rosenberger, Anthony Robinson, Pin Kung

A mixed integer linear programming (MILP) model is presented to optimize green building design over multiple performance objectives. Performance objectives are predicted via treed regression models developed using design and analysis of computer experiments with eQUEST software as the computer experiment. Results of single story building case study were studied. Future study includes sequential design of experiments to minimize the computer runs and improve the optimization.

■ TC60

Mezzanine - 100A

Joint Session DM/HAS/AI: System Modeling and Health Informatics

Sponsor: Data Mining, Health Applications, & Artificial Intelligence

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 E Fowler Ave. ENB118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Probabilistic Graphical Modeling Based on L1 Penalized Likelihood for Cancer Gene Network

Sung Won Han, Research Scientist, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com, Hua Zhong, Gong Chen, Anton Belousov, Laurent Essioux

Directed acyclic graphic model has been suggested to model the interactions among random variables where directed edges represent the causal influence of components of the system. This presentation discusses the estimation of the structure of the directed acyclic graph by the L1-penalized likelihood approach. We formulate the problem by a linear structure with latent variables under the assumption that the variances of latent variables are unequal and unknown, and a natural ordering is unknown.

2 - Impacts of Information Transmission and Human Behaviors in Epidemics: A Spatial Game Model

Chih-Hang(John) Wu, Associate Professor, Kansas State University, 2037 Durland Hall, Manhattan, KS, 66506, United States of America, chw@ksu.edu, David Ben-Arieh, Songnian Zhao

Information transmission plays an essential role in the dynamics of infectious disease transmission since individuals decides their behaviors based on the current information. Two types of impacts from information transmission to the spread of epidemics, called local impact and global impact, and the corresponding stability analysis are studied in this paper.

3 - Modeling, Grouping, and Monitoring of Nonlinear and Spatiotemporal Profiles

Gang Liu, University of South Florida, 4202 E Fowler Ave., Tampa, FL, 33620, United States of America, gliu@mail.usf.edu, Hui Yang

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■ TC61

Mezzanine - 100B

Data Mining in Health Applications

Sponsor: Data Mining

Sponsored Session

Chair: Chun-An (Joe) Chou, SUNY Binghamton, Binghamton, NY, 13902, United States of America, cachou@binghamton.edu

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■ TC62

Mezzanine - 100C

Data Fusion for Process Control

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Liu, Ph.D Candidate, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, United States of America, kbliu@gatech.edu

1 - within-cycle Monitoring and Diagnosis of Cyclic Nonlinear Profile Signals

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■ TC63

Mezzanine - 100D

The Modeling, Monitoring and Control of Systems using Complex Data (II)

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Kaibo Wang, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

Co-Chair: Fadel Megahed, Assistant Professor, Auburn University, 3301L Shelby Center, Auburn, AL, 36849, United States of America, fmegahed@auburn.edu

1 - A Change-point Approach for System Monitoring and Diagnosis using Multichannel Profiles

Kamran Paynabar, Georgia Institute of Technology, Atlanta, GA, United States of America, kamran.paynabar@isye.gatech.edu, Peihua Qiu, Changliang Zou

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2 - Opportunistic Condition Based Maintenance using Equivalent Age Model

Ali Aldubaisi, PhD Student, Auburn University, 3301 Shelby Center, Auburn, AL, 36849, United States of America, aza0050@tigermail.auburn.edu, Fadel Megahed

Equivalent age models are very flexible since they do not require the life distributions to be shape invariant. However, they have only been proposed to model the aging rate of a single machine and the available literature on developing maintenance strategies based on equivalent age is preliminary. Thus, the objective of our work is to allow for multiple machine configurations with dependencies, while triggering maintenance based on multiobjective optimization routines and experimental results.

3 - Quality Monitoring of Manufacturing Processes by In-process Sensor Signals

Marco Grasso, Dipartimento di Meccanica - Politecnico di Milano, Via La Masa 1, Milan, Italy, marco.grasso@musp.it, Bianca Maria Colosimo

An increasing attention in manufacturing industry has been devoted to the use of in-process signals to improve quality, productivity and automation. The analysis of real-time data streams leads to different challenges for quality control. Thus, signal pre-processing, registration and fusion techniques are critical for the achievement of desired performances. The paper investigates new methods and open issues related to the application of SPC and profile monitoring techniques to sensor data.

4 - A Run-to-Run Profile Control Algorithm for Improving the Flatness of Nano-scale Products

Xin Wang, PhD Candidate, Tsinghua University, Department of Industrial Engineering, Beijing, China, xinwang09@mails.tsinghua.edu.cn, Su Wu, Kaibo Wang

In scaling-up Carbon nanotubes (CNTs) array manufacturing, the geometric quality of the array is characterized by the flatness of a nonlinear profile. In this work, we propose a run-to-run profile controller based on a state-space model and Kalman filter to improve the flatness of the CNTs array. The performance of the proposed run-to-run control algorithm is studied and compared with existing controller via simulation studies.

■ TC64

Mezzanine - 100E

Health Information Technology

Sponsor: Information Systems

Sponsored Session

Chair: Rajib Saha, Assistant Professor, Indian School of Business, Room 6123, AC6, Level 1, Gachibowli, Hyderabad, AP, 500032, India, Rajib_Saha@isb.edu

1 - Partnership and Contracting between Regional Medical Centers and Rural Hospitals via Telemedicine

Balaraman Rajan, University of Rochester, Rochester, NY, United States of America, balaraman.rajan@Simon.Rochester.edu, Abraham Seidmann, Rajeev Ramachandran

We analytically investigate a partnership model between hospitals with the help of telemedicine. Our results explain how telemedicine may not always result in increased competition amongst hospitals serving the same general region but can also aid in forming a mutually beneficial partnership resulting in improved economic and clinical outcomes. While the regional hospitals gain by retaining their patients, medical centers win by being able to see patients who require their level of expertise.

2 - Hospital Switching and Duplicate Tests: Can Access to Patient Health Information Reduce Waste?

Sezgin Ayabakan, The University of Texas at Dallas, 800 W. Campbell Rd., Richardson, United States of America, sxa095020@utdallas.edu, Kirk Kersey, Indranil Bardhan, Eric Zheng

We investigate the impact of hospital switching on duplicate tests for Congestive Heart Failure patients. We use a comprehensive dataset of 39,600+ patient visits across outpatient clinics of 72 hospitals in North Texas from 2005 to 2012. Our results suggest that hospital switching is significantly and positively associated with duplicate testing. Our results support the need to implement health information exchanges to share patient medical data across hospitals and reduce waste.

3 - Emergency Care vs. Urgent Care

Ozden Engin Cakici, Assistant Professor, American University, Kogod School of Business, 4400 Massachusetts Avenue, Washington, DC, 20016, United States of America, cakici@american.edu, Rajiv Dewan, Marshall Freimer

As the number of hospital emergency departments (ED) decline many urgent care centers (UCC) have been opening. We model a strategic relationship between an ED and a UCC with strategic patients. Our model takes into account patient wait times, transportation costs and copays incurred for each facility.

■ TC65

Mezzanine - 100F

Determining Sentiment or Importance within Social Media

Cluster: Social Media Analysis

Invited Session

Chair: Christopher Smith, US Army, 1044 Autumn Hill Court, Crozet, VA, 22932, United States of America, christopher.m.smith@us.army.mil

1 - Social Media Intelligence for Regional Instability

Tom Sabo, Sr. Solutions Architect, SAS Federal LLC, 1530 Wilson Blvd. Suite 800, Arlington, VA, 22209, United States of America, tom.sabo@sas.com

SAS has analyzed social media relevant to Arab Spring to present visually and geospatially how indications of discontentment and stressor events in a region correlate with protest and instability. Such trend analysis can preempt the resurgence of militant groups and subsequent terrorist activity.

2 - The Paterno Riots: What Can Twitter Tell Us?

Andrew Todd, PhD Student, University of Virginia, 151 Engineer's Way, PO Box 400747, Charlottesville, VA, 22904-4747, United States of America, aet6cd@virginia.edu

Social networking sites are a source of public opinion on a wide range of topics from consumer products to politics. We examine Twitter content up to and during the firing of Joe Paterno and subsequent riots. We apply existing methods of sentiment analysis and suggest how metadata and information from the structure of social networks can be used to construct and enhance sentiment indicators. We test performance using standard tools from time-series and systems analysis.

3 - Value of Information Applied to Networks

Les Servi, The MITRE Corporation, 202 Burlington Road, Bedford, MA, United States of America, lservi@mitre.org, Christopher Smith, Andrew Todd, William Scherer, Stephen Carr

A methodology is proposed to compliment the subjective "value" of intelligence with an objective metric of "impact" of information on network models. It would measure the impact of a piece of information on a network's metric, in this case being used to answer intelligence analyst questions. In this paper, we explore data of tweets and apply the methodology to the links between twitter users to determine their quantitative impact on the overall network.

■ TC66

Mezzanine - 100G

Business Analytics for Social Media

Sponsor: Information Systems

Sponsored Session

Chair: Kaushik Dutta, National University of Singapore, 13 Computing Dr, Singapore, 117417, Singapore, duttak@nus.edu.sg

1 - Incorporating Social Influence in Customer Management Decisions

Ishwar Murthy, Professor, Indian Institute of Management Bangalore, IIM Bangalore, Bannerghatta Road, Bangalore, 560076, India, ishwar@IIMB.ERNET.IN, Sumit Sarkar

Customer interactions on social media can influence adoption, retention and usage of products and services. Current methods of computing customer lifetime value do not recognize peer influence. Hence, decision support models that maximize lifetime value may yield sub-optimal solutions. We propose a MDP based decision support model that incorporates lagged social influence while arriving at optimal policy for existing customer management.

2 - Influence and Influential Users in Online Health Communities

Kang Zhao, Asst. Professor, University of Iowa, S224 PBB, Iowa City, IA, 52242, United States of America, kang-zhao@uiowa.edu

What characterize influence and influential users in online health communities? Using sentiment analysis of users' online interactions, this research revealed sentiment influence in threaded discussions. It proposed a novel metric to effectively identify influential users. Text mining was used to find the difference between influential and non-influential posts. Findings of the study can help to manage online health communities and advance our understanding of social influence.

3 - Monetizing Viral Impressions: Advertiser Dependent Price Differentiation

Anwesha Bhattacharjee, University of Texas at Dallas, 2200 Waterview Pkwy., Apt. 1836, Richardson, TX, 75080, United States of America, axb094820@utdallas.edu, Vijay Mookerjee

Facebook does not price viral impressions of advertiser content losing out on revenue as sharing of ad content increases. This paper analyzes a price differentiation strategy for Facebook to discriminate between advertisers differing in viral content. Under the proposed model setup, Facebook maximizes revenue for ad content with low likelihood for sharing by charging a low premium followed by additional cost per viral view and a high premium with free shares for content likely to go viral.

■ TC67

Mezzanine - 100H

Aggregation of Expert Judgments

Sponsor: Decision Analysis

Sponsored Session

Chair: J. Eric Bickel, University of Texas, 1 University Station, C2200, ETC 5.128D, Austin, TX, 78712-0292, United States of America, ebickel@mail.utexas.edu

1 - Aggregation of Prediction Distributions using Debiased Quantile Estimates

Vicki Bier, University of Wisconsin-Madison, 1513 University Avenue, Room 3270A, Madison, WI, 53706, United States of America, bier@engr.wisc.edu, Chen Wang

We discuss how to estimate expert overconfidence and biases using Bayesian quantile regression. We can then broaden and shift each expert's distribution to offset any overconfidence or bias, and aggregate the adjusted distributions to obtain a consensus distribution. Such methods allow us to account for: (1) asymmetry around the median; (2) correlations between different quantiles given by the same expert; and (3) correlations between experts who represent the same school of thought.

2 - The Benefits of Averaging When Quantile Forecasts Bracket the Truth

Casey Lichtendahl, University of Virginia, Darden School of Business, 100 Darden Blvd., P. O. Box 6550, Charlottesville, VA, 22906, United States of America, lichtendahlc@darden.virginia.edu, Robert L. Winkler, Yael Grushka-Cockayne

Bracketing explains why averaging point forecasts performs no worse than the average point forecaster. We extend this notion to probabilistic forecasts. We assume each forecaster reports multiple quantiles and is evaluated with a linear scoring rule. We show that if there exists a u such that at least two of the forecasters' u-quantiles bracket the truth, then averaging quantile forecasts performs better than the average quantile forecaster; otherwise, it performs equally well.

3 - Aggregating and Distilling the Wisdom of Competitive Crowds

Asa Palley, Duke University, The Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708, United States of America, abp12@duke.edu, Jack Soll, Yael Grushka-Cockayne, Casey Lichtendahl

Forecasting competitions offer a simple and widely-used mechanism for eliciting judgments from many experts. However, when information is both publicly and privately available, individual forecasters have an incentive to distort their responses, and the competitive crowd's aggregated judgment overweights public information. We test these results experimentally and examine procedures that can be used in forecasting competitions to recover private signals and better aggregate crowd information.

4 - Combining Judgments with Evidence from Multiple Research Programs

Stephen Hora, Professor, University of Southern California, 3710 McClintock Ave., Los Angeles, CA, 90089, United States of America, hora@price.usc.edu

Risks from radiation exposures during mammography and from failure to detect malignancies must be balanced. Recent evidence has shown that a dose of radiation with a lower energy level may be more destructive than the same dose at a higher energy level. Data from epidemiology, animal, DNA, microdosimetry, and cellular radiobiology studies are used to assess the impact of different energy levels on the target human tissue.

■ TC68

Mezzanine - 100I

Decision Analytics in Finance

Sponsor: Decision Analysis

Sponsored Session

Chair: Arnav Sheth, Saint Mary's College of California, Moraga, CA, United States of America, aas3@stmarys-ca.edu

1 - Power-log Portfolio Optimization for Maximizing Portfolio Growth and Controlling Tail Risk

Arnav Sheth, Saint Mary's College of California, Moraga, CA, United States of America, aas3@stmarys-ca.edu, Jivendra Kale

Power-Log utility functions combine behavioral finance with multiperiod portfolio theory to represent investor preferences realistically. In this study we test portfolio optimization with Power-Log utility functions over multiple periods with annual rebalancing using a treasury security, the S&P500 index and a call option on the index. We find that optimal Power-Log portfolios deliver higher geometric average realized returns with lower tail risk, and surprisingly lower standard deviation than mean-variance efficient portfolios that have the same ex-ante expected returns. They also provide much better downside protection against large, negative return surprises, such as the down markets in 2002 and 2008.

2 - Price-bands: A Technical Tool for Stock Trading

Jinwook Lee, Rutgers University, Rutgers Business School, Piscataway NJ, United States of America, jinwook@rci.rutgers.edu

Given a stochastic process with known finite dimensional distributions, we construct lower and upper bounds within which future values of the stochastic process run, at a fixed probability level. For a financial trading business, such set of bounds are called "price-bands" or "trading-bands" that can be used as an indicator for successfully buying or short-selling shares of stock. In this paper, we present a mathematical model for the novel construction of price-bands using a stochastic programming formulation. Numerical examples using recent US stock market intraday data are presented.

3. A Game Theoretic Model of Financial Crises

Jonathan Welburn, PhD Student, University of Wisconsin - Madison, 1513 University Avenue, 3237 Mechanical Engineering Building, Madison WI 53706, United States of America, welburn@wisc.edu, Kjell Hausken

Global financial crises have revealed the systemic risk posed by economic contagion. We formulate a game between countries, central banks, banks, firms, households, and financial inter-governmental organizations to model the dynamics between the players. We model strategic choices, determine equilibrium solutions, and simulate the impacts of random shocks. Our conclusions enhance the understanding of global economic risk.

■ TC69

Mezzanine - 100J

Retail Management I

Contributed Session

Chair: Liang Lu, Lecturer, Heriot-Watt University, EF 17, Heriot-Watt University, Edinburgh, NA, EH14 4AS, United Kingdom, L.Lu@hw.ac.uk

1 - The Promise & Challenges Of Online Industrial By-Products Markets

Suvrat Dhanorkar, Doctoral Candidate, University of Minnesota, 3-150 Carlson School of Management, 321 19th Ave. S, Minneapolis, MN, 55455, United States of America, dhano002@umn.edu, Kevin Linderman, Karen Donohue

Our study explores the operations an electronic intermediary which facilitates the exchange of commercial and industrial by-products for reuse. We adopt a problem-driven approach aimed at increasing the overall utilization and efficiency of the online by-product exchange. We determine factors that drive three key metrics – buyer interest, supplier interest and exchange success.

2 - Scheduling an Online Retailer's Delivery Locker Boxes

Naser Nikandish, Student, Cornell University, 301 Sage Hall, Cornell University, Ithaca, NY, 14853, United States of America, nn93@cornell.edu, Lawrence Robinson

Delivery locker boxes have recently received significant attention from online retailers such as Amazon.com. The online retailer delivers goods into these locker boxes which customers can pick up at their convenience. The question that we address is how should the online retailer schedule delivery of goods to these boxes while accommodating the uncertainty in customers' pick up times.

■ TC70

Mezzanine -101A

Joint Session AAS/TSL: Predictability in the National Airspace System

Sponsor: Aviation Applications & Transportation Science & Logistics

Sponsored Session

Chair: David Lovell, Associate Professor, University of Maryland, 1173 Martin Hall, College Park, MD, 20742, United States of America, lovell@umd.edu

1 - Benefits Analysis of Improved Strategic and Operational Flight Predictability

Kleoniki Vlachou, PhD Candidate, University of Maryland, 1173 Glenn L. Martin Hall, College Park, MD, 20742, United States of America, kvlachou@umd.edu, David Lovell, Michael Ball

Two different categories of benefits are quantified in this research based on improvements in two levels of flight predictability: Strategic flight predictability refers to the long term statistical characteristics of the timing of flight operations; and operational flight predictability refers to the statistical characteristics of the response time and information accuracy given to the flight operators on a daily basis.

2 - Block Time Reliability and Airline Scheduled Block Time

Lu Hao, University of California,Berkeley, Berkeley, CA, United States of America, haolu@berkeley.edu, Mark Hansen

We investigate how the change in actual block time distribution will affect SBT and system performance. Firstly this relationship is studied with empirical data and multiple regression models. Using this behavior model, we generate different scenarios with hypothetical changes to actual block time distribution and evaluate the impacts on SBT, delay, and on-time performance. Taking the heterogeneity across airlines into consideration, we also decompose the dataset to study specific airlines.

3 - Impact of Predictability Improvements on Airline Scheduling Practices

Amber Woodburn, Graduate Student, University of Pennsylvania, 2514 Bruce Ave., Glenside, PA, 19038, United States of America, amber.woodburn@gmail.com, Megan Ryerson

Justification for airport capacity enhancements are often framed in terms of delay reductions, but improvements to predictability, or block time reliability, may also offer substantial benefit to the health of the aviation system. In a case study utilizing statistical methodologies, including cluster analysis and quantile regression, we identify how new runway infrastructure impacts the predictability of arriving flights, and, consequently, the variance in airline's scheduled block time.

4 - Analyzing the System-wide Impact of Equipage-based Air Traffic Flow Management Algorithms

Shervin Ahmadbeygi, Metron Aviation Inc., Reston, VA, United States of America, shervin.ahmadbeygi@metronaviation.com

We present algorithms to incorporate flight equipage information in Air Traffic Flow Management resource allocation mechanisms. These mechanisms enable proper management of mixed-equipage traffic and help flight operators utilize advanced avionics and increase operational efficiency. We use simulation to estimate the system-wide impact of those algorithms on airline operations.

■ TC71

Mezzanine -101B

Game Theory Applications I

Contributed Session

Chair: Ankur Mani, PhD Candidate, Massachusetts Institute of Technology, 20 Ames St., #385, Cambridge, MA, 02139, United States of America, amani@mit.edu

1 - Decentralized Multi-agent Network Interdiction Games

Harikrishnan Sreekumaran, Purdue University, 315 N. Grant St., School of Industrial Engineering, West Lafayette, IN, 47904, United States of America, harikrishnan@purdue.edu, Andrew Liu, Nelson Uhan

We present a class of multi-agent network interdiction games with multiple leaders interdicting adversaries who operate on a common network. We formulate such games as Generalized Nash Equilibrium Problems with non-shared constraints. We show that such games admit potential functions, enabling us to design algorithms based on best-response mechanisms that can be proven to converge to equilibria. We propose a decentralized multi-thread algorithm to enable efficient computation of such equilibria.

2 - Feedback Stackelberg Equilibrium in Mixed Leadership Games with an Application to Cooperative Advert

Anshuman Chutani, The State University of New York at Binghamton, School of Management PO Box 6000, Binghamton, NY, 13902, United States of America, achutani@binghamton.edu, Suresh Sethi, Alain Bensoussan, Shaokuan Chen

We study a class of sequential differential games where there are no clear leaders and followers as in the original definition of a Stackelberg equilibrium. We develop a procedure to obtain equilibrium in these mixed leadership differential games where players act both as leaders and followers depending on the nature of the decision. We then apply this to a game of cooperative advertising between a manufacturer and a retailer, who decide national and local advertising rates, respectively.

3 - Game Theoretic Approaches to Weight Assignments in DEA Problems

Jing Fu, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo, 1420053, Japan, fu.j.aa@m.titech.ac.jp, Satoru Sekine, Shigeo Muto

This paper deals with the problem of fairly allocating a certain amount of divisible goods or burdens among individuals or organizations in the multi-criteria environment. It is analyzed within the framework of data envelopment analysis (DEA). We improve the game proposed by Nakabayashi and Tone (2006) and develop an alternative scheme by re-assigning the total weight or power for the coalition members. Equilibria and solutions by the new DEA game are also studied in this paper.

4 - Alternating Offers Bargaining between a Team of Buyers and a Team of Sellers with Majority Voting

Ankur Mani, PhD Candidate, Massachusetts Institute of Technology, 20 Ames St., #385, Cambridge, MA, 02139, United States of America, amani@mit.edu, Wesley Gifford, Anshul Sheopuri

Business deals between two organizations are complex and often involve months of negotiations. Delays in agreement cause loss of time and money. We model this as an alternating offers bargaining game between two teams of heterogeneous agents, where team decisions are made by majority vote. We find that team composition and compensation structure determine if a deal occurs and the agreed upon price, and we characterize optimal compensation structures within the teams for several specific cases.

■ TC72

Mezzanine -101C

Systemic and Liquidity Risk

Cluster: Risk Management

Invited Session

Chair: Andreea Minca, Cornell University, Rhodes Hall, Ithaca, United States of America, acm299@cornell.edu

1 - Funding Liquidity Risk in a Game Theoretic Model with Recovery

Andrey Krishenik, Cornell, 292 Rhodes Hall, Hoy Rd., Ithaca, United States of America, ak757@cornell.edu, Andreea Minca, Robert Jarrow

We consider a one period model for a company that finances its operations through short-term debt. The company receives the money from a continuum of short-term lenders and invests in a risky, divisible asset, it can also hold a certain amount of liquid reserves, that we refer to as "cash". We find that it can be profitable for the company to hold some riskless "cash" as the investment.

2 - Obtaining Mutual Fund Performance Measures From Fund Networks

Anton Braverman, Cornell University, 289 Rhodes Hall, Ithaca, United States of America, ab2329@cornell.edu, Andreea Minca

Using a network of mutual funds, we examine several mutual fund performance measures that capture the systemic risk a fund faces from other funds with common asset holdings.

3 - Spot Trading vs. Hedging: Risk Management in Spot Market

Xuan Zhao, Associate Professor, Wilfrid Laurier University, 75 University Ave. W., Waterloo, On, N2J 3C5, Canada, xzhao@wlu.ca, Wei Xing

The spot market can effectively help firms to manage demand uncertainty by providing a continuous available trading platform. The spot price can also be viewed as a commonly observable underlying variable correlated with the demand uncertainty, thus firms can also enter into a forward contract to buy a certain units of a hedging asset at the spot price. We consider a two-echelon supply chain and explore the equilibrium risk hedging strategies.

4 - Systemic Risk with Central Counterparty Clearing
Andreea Minca, Cornell University, Ithaca, NY, United States of America, andreea.minca@gmail.com

We measure systemic risk in terms of a coherent valuation principle. The framework allows us to examine the effects on systemic risk and price contagion of multilateral clearing via a central clearing counterparty (CCP). We prove existence and uniqueness of an interbank payment equilibrium in conjunction with the price impact on external assets. We find that a CCP not always reduces systemic risk and provide sucient conditions for the latter to hold.

Tuesday, 4:30pm - 6:00pm

■ TD01

Level 2 - Room 200A

Energy Markets

Cluster: Optimization in Finance

Invited Session

Chair: Stathis Tompaidis, Associate Professor, McCombs School of Business, IROM Dpt., B6500, University of Texas at Austin, Austin, TX, 78712, United States of America, Stathis.Tompaidis@mccombs.utexas.edu

1 - Effects of Intermittent Resources on Investment
John Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Nur Sunar

Increased presence of intermittent resources, such as wind and solar, can increase volatility of electricity prices to the extent of increasing investment incentives for high-cost rapid-response generation. This talk will discuss this phenomenon and present a model for valuing these investment decisions based on an electricity model with jumps.

2 - Time-dependent Modeling via Additive Subordinators
Rafael Mendoza-Arriaga, Assistant Professor, University of Texas at Austin, IROM, CBA 5.202, Austin, TX, 78712, United States of America, Rafael.Mendoza-Arriaga@mccombs.utexas.edu, Lingfei Li

We characterize Ornstein-Uhlenbeck (OU) processes time-changed with additive subordinators as time-inhomogeneous Markov semimartigales, based on which a new class of commodity derivative models is developed. Analytical solutions are obtained for European and Bermudan futures options via eigenfunction expansions, with American option prices computed efficiently via extrapolation.

3 - Modeling the Electricity Supply Stack with Time-subordinated Processes
Stathis Tompaidis, Associate Professor, McCombs School of Business, IROM Dpt., B6500, University of Texas at Austin, Austin, TX, 78712, United States of America, Stathis.Tompaidis@mccombs.utexas.edu, Rafael Mendoza-Arriaga, Vishwakant Malladi

We present a framework for modeling the supply stack of electricity generators using time-subordinated processes. We demonstrate how the use of time-subordinated processes can be adapted to a factor structure that allows for correlated outages across generator types, geographical location, and links to the transmission network. We illustrate our model with a calibrated example for the ERCOT region.

4 - Joint Merchant Management of Natural Gas Storage and Transport Assets
Selvaprabu Nadarajah, PhD Candidate, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, snadaraj@andrew.cmu.edu, Nicola Secomandi

Natural gas pipeline systems embed storage and transport assets. The current literature has studied the management of these assets as separate real options. In contrast, we consider their joint merchant management. We develop near optimal approximate dynamic programming methods for the resulting Markov decision problem, leveraging our structural analysis of this model optimal value function and policy, and apply them to realistic instances to answer managerial questions.

■ TD02

Level 2 - Room 200B

Algorithms and Applications of Large Scale Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

Co-Chair: Necdet Serhat Aybat, Assistant Professor, The Pennsylvania State University, 220 Leonhard Bldg., University Park, PA, 16802, United States of America, nsa10@psu.edu

1 - Optimal Prima-dual Methods for a Class of Saddle-point Problems
Guanghui Lan, Assistant Professor, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, 32611, United States of America, glan@ise.ufl.edu, Yuyuan Ouyang, Yunmei Chen

We present a novel accelerated primal-dual (APD) method for solving both deterministic and stochastic saddle point problems (SPP). We demonstrate that the APD method achieves the same optimal rate of convergence as Nesterov's smoothing technique for deterministic SPP. Moreover, the stochastic APD method appears to be first optimal algorithm for stochastic SPP.

2 - An Augmented Lagrangian Method for Conic Convex Programming
Necdet Serhat Aybat, Assistant Professor, The Pennsylvania State University, 220 Leonhard Bldg., University Park, PA, 16802, United States of America, nsa10@psu.edu, Garud Iyengar

We propose an algorithm for solving (P): min{g(x)+f(x): Ax-b in K, x in Q}, where g and f are convex, and f has a Lipschitz cont. gradient, K is a closed convex cone, and Q is a convex compact set s.t. (SP): min{g(x)+|x-x0|_2^2: x in Q} is easy to solve. We show that any limit point is optimal, and the dual iterates converges to a KKT point of (P); and for any e>0, the iterates are e-feasible and e-optimal within O(log(1/e)) iterations which require solving O(1/e log(1/e)) many (SP).

3 - Hyperbolic Cone Programming: Structure and Interior-point Algorithms
Tor Myklebust, University of Waterloo, 200 University Ave. W., Waterloo, ON, N2L 6S7, Canada, tmyklebu@csclub.uwaterloo.ca, Levent Tuncel

I will first discuss some structural and geometric properties of convex cones which are hyperbolicity cones of some hyperbolic polynomial. Then, I will present some interior-point algorithms and their theoretical features on the hyperbolic cone programming problems. This talk is based on joint work with L. Tuncel.

4 - On the Connection between Bilinear Optimization and Compressed Sensing
Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

We study general nonconvex bilinear optimization problems over vector and matrix variables. In many cases, these problems are NP-Hard and thus we establish a framework for building efficient convex relaxations and study their quality. Our framework has applications in testing nullspace property from Compressed Sensing as well as Robust Optimization. We also establish connections with the existing approaches based on RLT and SDP based relaxations.

■ TD03

Level 2 - Room 200C

Recent Advances in Deterministic Global Optimization

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming

Sponsored Session

Chair: Aida Khajavirad, IBM TJ Waston Research Center, 1101 Kitchawan Rd., Yorktown Heights,New York, United States of America, aidakhajavi@us.ibm.com

1 - Continuous Dynamical Systems for Global Optimization

Amir Ali Ahmadi, Goldstine Fellow, IBM Watson Research Center, 1101 Kitchawan Rd., Yorktown Heights, NY, United States of America, a_a_a@mit.edu, Sanjeeb Dash, Oktay Gunluk

We explore connections between stability of equilibrium points of cubic differential equations and feasibility of basic semialgebraic sets. This allows for (i) a methodology for providing certificates of infeasibility of such sets presented as Lyapunov functions and obtained by semidefinite programming, and (ii) a heuristic for finding feasible solutions to a broad class of constraint satisfaction problems by simulating the solution of a differential equation.

2 - A Hybrid LP/NLP Paradigm for Global Optimization Relaxations

Nick Sahinidis, Swearingen Professor, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, sahinidis@cmu.edu, Aida Khajavirad

Polyhedral relaxations currently constitute the dominant approach in global optimization practice. In this paper, we introduce a new relaxation paradigm for global optimization. The proposed framework combines polyhedral and convex nonlinear relaxations, along with fail-safe techniques, convexity identification at each node of the search tree, and learning heuristics for automatic sub-problem algorithm selection. We report extensive computational experiments with the proposed relaxations.

3 - Strong Valid Inequalities for the Point Packing Problem

Aida Khajavirad, IBM TJ Waston Research Center, 1101 Kitchawan Rd., Yorktown Heights,New york, United States of America, aidakhajavi@us.ibm.com

We consider the problem of packing equal circles in a square. We pose this problem as a global optimization problem and study some important properties of the convex hull of the feasible set. We present new classes of cutting planes to approximate the polyhedral convex hull and compare their strength with existing relaxations.

■ TD04

Level 2 - Room 200D

Advances in Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Marco Molinaro, Carnegie Mellon University, molinaro@cmu.edu

1 - Polyhedral Results for Unsplittable Flow Problems

Jean-Philippe Richard, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, richard@ise.ufl.edu, I. Ece Icyuz

We study a single-node network where a balance equation is imposed on incoming and outgoing arcs. We also require that each nonzero incoming flow be paired with a single outgoing flow of same value, and vice-versa. This model is a relaxation of practical railroads problems where flow can be split at some nodes but not at others. We propose a polynomial extended formulation and describe families of facet-defining inequalities in the original space of variables. We present computational results.

2 - Minimal Valid Inequalities for Constrained Infinite Relaxations of MILPs

Sercan Yildiz, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, syildiz@andrew.cmu.edu

Our results are relevant to the theory of cutting planes for mixed integer linear programs (MILP). We consider the infinite relaxation of a MILP in tableau form. We first generalize a classical result of Gomory and Johnson which characterizes minimal valid inequalities for this model. We then use this characterization to establish necessary conditions for the unique lifting of inequalities obtained for a variant of this model in which all nonbasic variables are continuous.

3 - Strengthened MILP Formulations for Indicator Activated Piecewise-linear Functions

James Luedtke, Assistant Professor, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, jrluedt1@wisc.edu, Jeff Linderoth, Srikrishna Sridhar

We consider mixed-integer linear programming formulations for piecewise-linear functions that are evaluated only when an indicator variable is turned on. A direct application of standard MIP formulations for such PLFs yields a formulation that is not locally ideal. We describe a simple alternative that is locally ideal, and demonstrate its computational advantage.

■ TD05

Level 2 - Room 200E

Stochastic Programming of Nonlinear Processes

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Cristian Rodriguez Rivero, Professor, Universidad Nacional de Cordoba, Velez Sarsfield Ave. 1611, Cordoba, Co, 5000, Argentina, cristian.rodriguezrivero@gmail.com

1 - A New Algorithm and Numerical Experiments for a Multiple-period, Multiple-product Inventory Problem

Kai Luo, Assistant Professor, Euromed, BP 921, Luminy, Marseille, France, kai.luo@euromed-management.com, Ramesh Bollapragada, Laoucine Kerbache

We investigate the cases where two capacitated suppliers produce two products for a limited-shelf-space retailer in a multiple period horizon. Demand is stochastic and unmet demand is assumed to be lost. We show that an uncapacitated transformed problem is L-nature-convex. We also provide an upper bound of the optimal solution for the original capacitated problem and a new algorithm to search for near-optimal solutions. The effectiveness of the algorithm is tested via numerical examples.

■ TD06

Level 2 - Room 200F

Social Network Analysis II

Sponsor: Optimization/Networks

Sponsored Session

Chair: Alexander Nikolaev, Assistant Professor, University at Buffalo (SUNY), 312 Bell Hall, Buffalo, NY, 14260-2050, United States of America, anikolae@buffalo.edu

1 - On the Minimum k-Connected Subgraph

Chitra Balasubramaniam, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, bcvaidyanath@neo.tamu.edu, Sergiy Butenko

Node connectivity is a property of a network that can be used as a good measure of cohesion in social networks. We explore the problem of finding the smallest possible subgroup in a social network that can uniformly maintain high connectivity, and be robust to disruptions.

2 - Peer Effects in Large Social Networks: Generalized Renormalization Group Methods

Eugene Perevalov, Lehigh University, 200 W Packer Ave., Bethlehem, PA, 18015, United States of America, eup2@lehigh.edu, Abhijit Deshmukh, Brandon Pope

Peer effects in social networks can be used to either amplify or negate an effect of external intervention, depending on the nature of the latter. To be able to make use of these phenomena one needs to know what the possible large-scale effects of the given type of intervention are, how they depend on network parameters and what intervention policy has to be to take full advantage of the network structure. We propose a generalized renormalization group approach to address these issues.

3 - Stochastic Modeling Approaches to Influence Maximization in Social Networks

Mohammadreza Samadi, Graduate Research Assistant, University at Buffalo, the State University of New York, University SUNY, 327 Bell Hall, Buffalo, NY, 14260, United States of America, msamadi@buffalo.edu, Alexander Nikolaev, Rakesh Nagi

This paper introduces a diffusion model based on the idea of exponentially distributed lag between until product or opinion adoption. Memorylessness property of the exponential distribution allows for handling the dependence between the lag rate and the state vectors of potential adopters in a social network.

4 - Searching for Needles in a Haystack: Efficient Intelligence Collection

Nedialko Dimitrov, Naval Postgraduate School, 1411 Cunningham Road, Monterey, CA, 93943, United States of America, ned@nps.edu, Moshe Kress

For intelligence agencies, typically, much more data is available than what can be screened in the allotted time. We formulate the problem faced by an intelligence screener as an exploration-exploitation problem: the screener has to choose between exploring for new sources of information and exploiting known sources. We develop a mathematical model of the collector's knowledge and examine algorithms that allow the collector to maximize the discovery of relevant data given a time limit.

■ TD07

Level 2 - Room 200G

Data-driven Optimization

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Gah-Yi Vahn, Assistant Professor, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, gvahn@london.edu

1 - Distributionally Robust Convex Optimization

Wolfram Wiesemann, Imperial College, 180 Queen's Gate, London, SW7 2AZ, United Kingdom, ww@imperial.ac.uk, Daniel Kuhn, Melvyn Sim

Distributionally robust optimization (DRO) considers stochastic decision problems where the uncertain problem parameters are governed by a probability distribution that is itself subject to uncertainty. In this talk, we propose a unifying framework for modeling and solving DRO problems. We determine sharp conditions under which DRO problems are computationally tractable. We also provide tractable conservative approximations for problems that violate these conditions.

2 - The Data-driven Newsvendor: New Bounds and Insights

Joline Uichanco, Massachusetts Institute of Technology, Cambridge, MA, United States of America, uichanco@mit.edu, Retsef Levi, Georgia Perakis

We study the newsvendor model where the only demand information available is a set of independent samples drawn from the demand distribution. We analyze the solution from the sample average approximation (SAA) and its "regret" with respect to the true distribution. New tight analysis reveals that the weighted mean spread of a distribution impacts the regret of the SAA solution. For log concave distributions, we derive a bound on regret of the SAA solution independent of distribution parameters.

3 - A Big Data Approach to the Newsvendor Problem

Gah-Yi Vahn, Assistant Professor, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, gvahn@london.edu, Cynthia Rudin

We present how one can incorporate big data to the newsvendor problem. We also present preliminary theoretical and empirical findings.

4 - The Value of Stochastic Modeling in Two-stage Stochastic Programs

Erick Delage, Assistant Professor, HEC Montréal, 3000 Ch. de la Cote-Sainte-Catherine, Montreal, QC, H3T2A7, Canada, erick.delage@hec.ca, Yinyu Ye, Sharon Arroyo

Decisions often need to be made with incomplete knowledge about some parameters of the problem. While formulating a stochastic model that captures accurately this knowledge can be a costly task, solving a stochastic program simply based on historical data can provide useful guidance. Unfortunately, one might worry of being misled by such a simplistic view. In this work, we propose tractable methods for bounding the improvements that could be achieved with a more accurate/expensive model.

■ TD08

Level 2 - Room 200H

Constraint Programming III

Sponsor: Computing Society

Sponsored Session

Chair: Willem-Jan van Hoeve, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, vanhoeve@andrew.cmu.edu

Co-Chair: John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, jh38@andrew.cmu.edu

1 - New Features of the AMPL Constraint Programming Interfaces

Victor Zverovich, AMPL Optimization Inc, 1732 Anza Street, Apt 4, San Francisco, CA, United States of America, viz@ampl.com

The AMPL modeling system now provides interfaces to several constraint programming solvers: IBM/ILOG CP Optimizer, Gecode and JaCoP. These interfaces have been updated to allow getting multiple solutions in a unified way, using variable attributes (suffixes) to control branching and defining table constraints. Also some special cases of logical constraints in AMPL are mapped to more efficient representations in CP solvers.

2 - Constraint Programming in AIMMS

Deanne Zhang, AIMMS, 500 108th Ave. NE, Ste. 1780, Bellevue, WA, 98005, United States of America, Deanne.Zhang@aimms.com, Gertjan de Lange

Constraint Programming is a paradigm useful in formulating and solving highly combinatorial problems in addition to MIP solvers. With the Constraint Programing functionalities in AIMMS, we are able to take advantage of both – by combining the two methods together to solve a combinatorial problem. We will compare the different formulations, use different solving techniques, and analyze the results using the tools in AIMMS.

3 - Modeling with Metaconstraints and Semantic Typing of Variables

Tallys Yunes, University of Miami, School of Business Administration, Coral Gables, FL, 33124-8237, United States of America, tallys@bus.miami.edu, John Hooker, Andre Cire

A metaconstraint is a constraint endowed with behavioral parameters for relaxation, branching, and inference. Relaxations of metaconstraints introduce new auxiliary variables that are related to other variables in the model. Semantic typing facilitates the detection and enforcement of such relations by giving variables a specific meaning, yielding stronger models. It also provides other modeling benefits, such as error detection. We motivate and illustrate these concepts through examples.

■ TD09

Level 2 - Room 200I

Supply Chain Analytics

Sponsor: Analytics Section

Sponsored Session

Chair: Jian Yang, Associate Professor, Rutgers University, 1 Washingtong Park RM 1084, Newark, NJ, 07102, United States of America, jyang@business.rutgers.edu

1 - A Markov Chain Modulated Inventory Model

Michael Katehakis, Professor and Chair, Rutgers University, MSIS Department, 94 Rockafeller Road, Piscataway, NJ, 08854, United States of America, mnk@rutgers.edu, Isaac Sonin

We model a firm that consumes a fixed amount of certain commodity per one unit of time. At any period the firm can buy any amount of the commodity at the current, Markov modulated, price, or use "stored" commodity paying storage cost. A strategy is a vector of levels specifying the minimal commodity amount to keep for a given price. We present a polynomial time algorithm to calculate a nearly optimal strategy as well as the value function, using, at each step, only one-dimensional optimization.

2 - Project Management in Clinical Trial Supply Chains

Anh Ninh, Rutgers University, 640 Bartholomew Road, Piscataway, NJ, 08854, United States of America, anhninh@rci.rutgers.edu, Yao Zhao, Adam Fleischhacker

One bottleneck in clinical trials is the slow patient recruitment. Companies typically address this issue by recruiting patients globally, which, however, resulted in significant overages of clinical supplies. In this study, we introduce a class of mathematical models to capture the unique attributes of clinical trial supply chains. We show how to optimally position inventory in such supply chains, and test the impact of the network structure to the problem solution.

3 - A Link between Sequential Semi-anonymous Nonatomic Games and Their Large but Finite Counterparts

Jian Yang, Associate Professor, Rutgers University, 1 Washingtong Park RM 1084, Newark, NJ, 07102, United States of America, jyang@business.rutgers.edu

We show that a Markov equilibrium of a sequential semi-anonymous nonatomic game can be adopted by players in corresponding large but finite games to achieve near-equilibrium payoffs. Such an equilibrium is parsimonious in form—oblivious of past history and blind to other players' current status, and is easy to execute. We propose an asymptotic resemblance concept between two sequences of probability measures to achieve this result.

■ TD10

Level 2 - Room 200J

Joint Session INFORM-ED/Analytics: Teaching Business Analytics: Best Practices I

Sponsor: INFORM-ED & Analytics

Sponsored Session

Chair: Eric Huggins, Fort Lewis College, 1000 Rim Drive, Durango, CO, United States of America, huggins_e@fortlewis.edu

1 - Teaching Business Analytics: Lessons-Learned

Jim Van Scotter, Associate Professor, Louisiana State University, Dept of ISDS, Baton Rouge, LA, 70803, United States of America, jvanscot@lsu.edu, Helmut Schneider

An M.S.in Analytics program needs more than "big data" and sophisticated software to create value. Students and faculty must focus on understanding the business case for analytics, the potential gains and implementation costs, and how to communicate results effectively to decision makers. Evaluation strategies must emphasize team work and results over individual testing. Finally, establishing and maintaining close relationships with companies that use analytics is critically important.

2 - Challenges of using a Client's Data Set: A Skill Students Were Not Taught

Kenneth Chelst, Wayne State University, Detroit, MI, United States of America, kchelst@wayne.edu

Students typically learn data analysis with high quality data sets. In the real world obtaining data from a client and then processing it is fraught with many pitfalls. We describe our experiences in guiding students in a) identifying the available data, b) requesting the data, c) assessing the quality and completeness of the data d) linking together multiple data files, e) submitting a revised request for data and e) dealing with missing data, inaccurate data, and outliers. This iterative process usually takes months.

3 - On Developing a Business Analytics Course and Major at a Small Business School

Eric Huggins, Fort Lewis College, 1000 Rim Drive, Durango, CO, United States of America, huggins_e@fortlewis.edu

This year I designed and taught a new Business Analytics course which succeeded in a number of ways and failed spectacularly in a few others. I will discuss my lessons learned and directions for the course in the future. Further, I am in the process of developing a Business Analytics major and I will discuss my progress so far and seek input from those who have gone before me.

■ TD11

Level 2 - Room 201A

Joint Session WORMS/JFIG/MIF: Speed Networking

Sponsor: Women in OR/MS, Junior Faculty Interest Group, & Minority Issues

Sponsored Session

Chair: Susan Martonosi, Associate Professor of Mathematics, Harvey Mudd College, 301 Platt Blvd., Claremont, CA, United States of America, martonosi@g.hmc.edu

Co-Chair: Esra Buyuktahtakin, Assistant Professor, Wichita State University, 1845 Fairmount St., Wichita, 67260, United States of America, Esra.Buyuktahtakin@wichita.edu

Co-Chair: Laura McLay, Associate Professor, University of Wisconsin-Madison, Industrial & Systems Engineering, Madison, WI, 53706, United States of America, lmclay@wisc.edu

Co-Chair: Julie Ivy, Associate Professor, North Carolina State University, Edward P. Fitts Department of Industrial, 400 Daniels Hall, Raleigh, NC, 27695-7906, United States of America, jsivy@ncsu.edu

1 - Speed Networking

Are you looking for a new research collaborator? Eager to branch out into a new area of research? Looking to establish professional connections outside of your institution? WORMS, MIF and JFIG invite you to this Speed Networking session. Participants will be grouped according to broad research interests and will meet successively in pairs to share research backgrounds and contact information. Bring your business cards!

■ TD12

Level 2 - Room 201B

Stochastic Optimization with Applications in Power System Operations

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Yongpei Guan, University of Florida, 303 Weil Hall, Gainesville, United States of America, guan@ise.ufl.edu

Co-Chair: Ruiwei Jiang, University of Florida, 411 Weil Hall, University of Florida, Gainesville, FL, 32611, United States of America, rwjiang@ufl.edu

1 - Unified Stochastic and Robust Unit Commitment

Chaoyue Zhao, University of Florida, United States of America, cherryzhao09@ufl.edu, Yongpei Guan

In this talk, we propose a unified stochastic and robust approach to provide day-ahead unit commitment decisions. By introducing weights for the components for the stochastic and robust parts in the objective function, this innovative model can achieve a low expected total cost while ensuring the system robustness. Finally, a Benders' decomposition algorithm is developed to solve the model efficiently. The computational results verify our proposed approach and algorithm.

2 - Electricity Market-Clearing using Decision Rule Approximations for Stochastic Programming

Jianhui Wang, Affiliate Professor, Auburn University, 9700 S. Cass Avenue, Bldg. 221, Argonne, IL 60439, USA, Argonne, IL, 60439, United States of America, jianhui.wang@anl.gov, Daniel Munoz-Alvarez

This work explores traditional and extended linear decision rules as approximations to solve the originally intractable multi-stage stochastic program. The performance of these approximations is studied for a multi-period day-ahead electricity market clearing based on co-optimized forward energy and flexibility (i.e., reserve) contracts.

3 - Risk-averse Stochastic Unit Commitment with Incomplete Information

Ruiwei Jiang, University of Florida, 411 Weil Hall, University of Florida, Gainesville, FL, 32611, United States of America, rwjiang@ufl.edu, Yongpei Guan

In this talk, we propose a risk-averse stochastic unit commitment model to hedge against incomplete information upon the volatile renewable energy. Our proposed model is based on real data samples collected in practice, and can ensure renewable energy utilization with a high probability. Furthermore, we analyze the convergence property of the risk-averseness of the model as the sample size grows.

■ TD13

Level 2 - Room 202A

New Product Development III: Customer Interaction

Contributed Session

Chair: Xin Xu, Rutgers University, 249 Belleville Ave., Unit 54D, Bloomfield, NJ, 07003, United States of America, xin.xu.2009@rutgers.edu

1 - Determiners of User-firm Collaboration Network Performance in CT Scanner

Yutaka Hamaoka, Professor, Keio University, 2-15-45, Mita, Minato-ku, 1038345, Japan, hamaoka@fbc.keio.ac.jp, Kanoko Go

Analyzing the Japanese patent data for a CT scanner whose users are highly knowledgeable doctors, this research examines the determiners of the creation and diffusion of innovation. Based on the stickiness of information theory (von Hippel, 1994) and the structural hole theory (Burt, 1992), a set of hypotheses is proposed. They are empirically tested with Japanese patent data.

2 - Diagnosis of Customer Preference for BTO Products
Yuji Sato, Professor, Chukyo University, 101 Yagotohonmachi, Showa, Nagoya, 466-8666, Japan, ysatoh@1988.jukuin.keio.ac.jp

This paper studies a diagnosis procedure of new BTO products which takes into user's preference for the system for a manufacturing company. This paper addresses this issue by combining cost-benefit analysis evaluating potential treatment system, and the AHP quantifying subjective judgment in evaluations. A case study is carried out to demonstrate the applicability of the proposed approach.

3 - An Empirical Analysis of the Role of Customer Interaction in Project Crowdfunding
Philipp Cornelius, MRes Student, University College London, Gower Street, London, WC1E 6BT, United Kingdom, philipp.cornelius.12@ucl.ac.uk, Bilal Gokpinar

Companies increasingly involve customers in their product development efforts. Customer interaction during new product development (NPD) projects can be a valuable contribution as well as a jeopardous threat to project outcomes. Using large-scale data set, we investigate such tensions surrounding customer interaction in a project crowdfunding environment.

4 - Partnerships In Project Management
Xin Xu, Rutgers University, 249 Belleville Ave., Unit 54D, Bloomfield, NJ, 07003, United States of America, xin.xu.2009@rutgers.edu, Yao Zhao

We consider a product development project where the design work of subsystems is outsourced to suppliers. We build a mathematical model to predict each firm's behavior under loss sharing partnership. We show each firm tends to delay its task relative to what is the best for the entire project as a whole.

■ TD14

Level 2 - Room 202B

OR Practice in Supply Chain Management

Contributed Session

Chair: Ioannis Fragkos, PhD Candidate, University College London, The Downs 22, London, SW20 8HT, United Kingdom, i.fragkos@ucl.ac.uk

1 - Modeling Business Value of Global Planning at 3M Company
Muer Yang, Assistant Professor, University of St. Thomas, 1000 LaSalle Avenue, SCH 435, Minneapolis, MN, 55403, United States of America, yangmuer@stthomas.edu, Sameer Kumar, Dan Strike

The study assesses the value of planning supply chains globally in a single planning model compared to the current state where intra-company (between 3M subsidiaries) demands are treated as external demands. Simulation models for the two supply chain structures are developed and a full factorial experimental design is used to evaluate the study outcomes.

2 - Taconite Supply Chain: A Case Study
Qingyu Zhang, Associate Professor, ASU, College of Business, State University, United States of America, q.yu.zhang@gmail.com, Mei Cao

Many supply chain studies focus on the manufactured products while few concentrate on commodities such as taconite iron ore. By a case study, the research examines the supply and demand sides of taconite supply chain and taconite transportation, identifies its characteristics, and develops strategies for managing the taconite supply chain.

3 - A Longitudinal View on the Value-relevance of Analyst Opinion on Supply Chain Management Excellence
Suvankar Ghosh, Assistant Professor, University of South Dakota, 414 E. Clark Street, Vermillion, SD, 57069, United States of America, Suvankar.Ghosh@usd.edu

This study employs an event study methodology to examine the value-relevance of the information contained in the Supply Chain Top 25 (SCT25) list published annually by noted analyst firm Gartner on the companies that excel in supply chain management. We study the value-relevance of the SCT25 since its inception in 2004 under both the strong and the weak form of the Efficient Market Hypothesis (EMH).

4 - Modeling Maritime Transshipment Operations for Noble Group Ltd using Mathematical Programming
Ioannis Fragkos, PhD Candidate, University College London, The Downs 22, London, SW20 8HT, United Kingdom, i.fragkos@ucl.ac.uk, Bert De Reyck

We present a MIP-based decision support system for the scheduling of transshipment operations of the Noble Group, a global supply chain manager of energy products. Coal is transported from river jetties to ocean vessels using barges and floating cranes. Noble pays huge penalties for late deliveries, as well as for spot resources hired to reduce the impact of delays. Our model reduces the combined cost of penalties and spot resources, and improves the efficiency of the transshipment operations.

■ TD15

Level 2 - Room 203

Best Paper Award – Competitive Presentations III, Service Science Section

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, Distinguished Professor, National Taiwan University, 1, Sec. 4, Roosevelt, Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw

1 - An Application of Capability Analysis and Simulation to Improve Patient Flow at an Off-Site ED
John F. Kros, Professor, East Carolina University, 3205 Harold Bate Building, Greenville, NC, 27858, United States of America, KROSJ@ecu.edu, Evelyn Brown

A low-acuity Emergency Department (ED) struggles to meet its service level goal. An analysis of existing data revealed that the facility is not capable of meeting its existing service level goal. To examine multiple alternatives to improve patient flow at the facility a simulation were developed. Recommendations to the facility for alternative ways to schedule and allocate its resources in order to meet its current service level goal were made based on the results of the simulation.

2 - Overloaded Service System with Scoring-Based Priority Rules
Yichuan Ding, University of British Columbia, 4735 W 4th Ave., Vancouver, BC, V6T1C3, Canada, Daniel.Ding@sauder.ubc.ca, Peter Glynn, Stefanos Zenios

We consider a service system with multitype customers and service providers. Whenever a service provider tries to deliver service, each customer is assigned a score that depends on customer type, duration of waiting time, and server type. The service is then provided to the customer with the highest score. We approximate the behavior of such a system using a fluid limit process, and characterize its steady-state as well as transient behavior using combinatorial optimization methods.

3 - An Equilibrium Model of Online Shopping Supply Chain Networks with Service Capacity Investment
Patrick Qiang, Penn State University, 30 E. Swedesford Rd., Malvern, PA, 19355, United States of America, qzq10@psu.edu, Yihong Hu

We propose an online shopping supply chain network model including manufacturers, e-tailers, express service providers, and consumers. Consumers purchase products from e-tailers which can be delivered either by the express service companies or can be picked up by customers depending on the consumer's preference on time and cost. The express service companies can also invest to improve their service quality. Theoretical results are presented and numerical examples are provided for illustration.

4 - At Your Service?: Consumer's Return Behavior and Retailer's Profitability
M. Ali Ulku, Assistant Professor, School of Business, Capital University, 1 College and Main, Columbus, OH, 43209, United States of America, aulku@capital.edu, Lynn C. Dailey, Muge H. Yayla-Kullu

Consumers expect that they can return goods if they are dissatisfied with them. Although they act as risk-relievers, such product returns significantly impact retailers' profits not only due to reduction in net sales, but also due to increased costs. In a retailer-consumer setting, we determine the profit-maximizing price and return period. We find that even with fraudulent consumers' negative effect on sales, a retailer can still achieve high profits with an optimally determined return policy.

■ TD16

Level 2 - Room 204

Optimization Models and Techniques in Radiation Treatment Planning

Sponsor: Health Applications

Sponsored Session

Chair: Hamid Ghaffari, Postdoctoral Fellow, University of Maryland, 22 S Greene, Baltimore, United States of America, ghaffari@mie.utoronto.ca

Co-Chair: Dionne Aleman, University of Toronto, 5 King's College Rd., Toronto, Canada, aleman@mie.utoronto.ca

1 - A Study of the Interplay Effect in Intensity Modulated Proton Therapy for Lung Tumors

Gino Lim, Associate Professor, University of Houston, Department of Industrial Engineering, E206 Engineering Building 2, Houston, TX, 77204-4008, United States of America, ginolim@uh.edu, Laleh Kardar, Wenhua Cao

In this study, the 4D dynamic dose was calculated by simulating the intensity modulated proton therapy (IMPT) delivery process along with the moving lung tumor target described by 4D CTs. Timestamps of switching irradiation fields, proton energies, scanning spots were linked to patient respiratory cycles. The impact of interplay effects for IMPT lung treatment plans was evaluated and new "repainting" schemes for mitigating the interplay effects was also explored.

2 - Mixed-integer and Linear Approximation Models for Continuous Path Treatment Planning for Stereotactic

Kimia Ghobadi, University of Toronto, 5 King's College Road, Toronto, On, M5S 3G8, Canada, kimia@mie.utoronto.ca, Dionne Aleman, David Jaffray, Mark Ruschin

We explore continuous dose delivery in treatment plans for Gamma Knife Perfexion. We first select a path in the tumor, along which the radiation will be deposited, and then develop mixed-integer models (and their linear approximations) to find the optimal beam durations for the chosen path. Several criteria are considered, including speed and movement accuracy. Our models yield clinically acceptable treatments while improving treatment time compared to forward and inverse step-and-shoot plans.

3 - A Stochastic Optimization Approach to Adaptive Lung Radiation Therapy Treatment Planning

Troy Long, University of Michigan, 1205 Beal Avenue, Room 1791, Ann Arbor, MI, 48109, United States of America, troylong@umich.edu, Edwin Romeijn, Marina Epelman, Martha Matuszak

Biomarker data obtained during treatment has been shown to be predictive of a patient's predisposition to radiation induced lung toxicity (RILT). We develop a two-stage stochastic treatment plan optimization model to explicitly consider future patient-specific biomarker data. Two adaptive strategies are studied: bounding the expected proportion of the entire population that will experience RILT, and bounding the probability that each individual patient will experience RILT.

4 - Predicting Objective Function Weights for Multi-Criteria IMRT Planning using Patient Anatomy

Taewoo Lee, University of Toronto, 5 King's College Road, Toronto, ON, M4Y3G8, Canada, taewoo.lee@utoronto.ca, Muhannad Hammad, Timothy Chan, Tim Craig, Michael B. Sharpe

Objective function weights for multi-criteria optimization for IMRT treatment planning are typically determined in a trial-and-error manner. We develop a regression model to predict the weights for prostate treatment planning using a previously developed inverse optimization method and patient anatomy. Treatment plans generated by the predicted weights were very similar to clinical treatment plans. This approach may support the genesis of personalized weights in IMRT treatment planning.

■ TD17

Level 2 - Room 205A

Human Resources

Sponsor: Service Science

Sponsored Session

Chair: Pankaj Dayama, IBM, Bangalore, India, pankajdayama@in.ibm.com

1 - Estimating Human Resource Needs to Achieve Universal Anti-retroviral Treatment Coverage for HIV/AIDS

Salal Humair, Research Scientist, Harvard School of Public Health, 665 Huntington Avenue, Building 1, Room 1102, Boston, MA, 02115, United States of America, shumair@hsph.harvard.edu, Till Barnighausen, David Bloom

Universal antiretroviral treatment (ART) coverage remains a central but distant goal of global HIV efforts, even after a decade of remarkable expansion in ART programs. A fundamental challenge associated with this goal involves putting in place the necessary human resources. We formulate a model to estimate the human resource needs accounting for both the mortality reduction and prevention effects of ART. We discuss the policy implications of our results.

2 - Engineering Management & Analytics Star in Cost-Saving Modifications for Travel Procedures

John Dulin, Enterprise Ventures Corp, 771 Fairdale Ct, Castle Rock, CO, 80104, United States of America, dulinj@ctc.com, Ashlee Knapp

Separately, unexpected travel fees and trip expenditures beyond forecasts may not seem significant; but together they can have a large impact on budgets. We searched internally to recognize and validate areas that contribute to over-spending. Research areas focused on time deltas: planning to booking, booking to travel, and advanced airfare purchase. By modeling travel procedures and analyzing corresponding data, we discovered streamlining opportunities that could lessen excessive travel costs.

3 - External Market Data Driven Compensation Planning for Retention Management

Munish Goyal, IBM, India, munish.goyal@in.ibm.com, Raymond Ngai, Pankaj Dayama, Sri Harsha Wdaru, Raphael Ezry

Unpredictability in employee attrition trend across various sectors, affected by the current economic conditions, has rendered firms' compensation plans in achieving their business goals ineffective. We marry competitive market data and strategic business goals of a firm to evaluate goal feasibility, compute retention costs, study tradeoff analysis between attrition target level vs investment, and design surgical compensation actions that maximizes net benefit for any given feasible target.

■ TD18

Level 2 - Room 205B

Solid Organ Transplant Operations

Cluster: Tutorials

Invited Session

Chair: Diwakar Gupta, Professor, University of Minnesota, 130B Mechanical Engineering, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, guptad@me.umn.edu

1 - Solid Organ Transplant Operations

Diwakar Gupta, Professor, University of Minnesota, 130B Mechanical Engineering, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, guptad@me.umn.edu

The extreme shortage of organs makes it necessary to prioritize allocation of diseased-donor organs. The difficult task of setting such priorities rests with the Organ Procurement and Transplantation Network. This talk will describe efforts to improve Simulated Allocation Models, which are tools used by the Scientific Registry of Transplant Recipients to evaluate the impact of proposed allocation policies on the distribution of organs, waitlist statistics, and post-transplant outcomes.

■ TD19

Level 2 - Room 205C

Stochastic Models and Applications - II

Sponsor: Applied Probability

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, Madison, WI, United States of America, ananth@engr.wisc.edu

1 - Dynamic Resource Allocation for Manufacturing System with Multiple Products with Seasonal Demands

Sanket Bhat, University of Wisconsin-Madison, Madison, WI, United States of America, sbhat2@wisc.edu, Ananth Krishnamurthy

We analyze manufacturing firms that can vary production capacities and target inventory levels to adapt to seasonal demands for products. Based on a dynamic programming model, we characterize the structure of the optimal policies. We also identify the optimal production capacities and length of production runs for each season.

2 - Optimal and Asymptotically Optimal Policies for Assemble-to-Order Systems

Jeannette Song, Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, jingsheng.song@duke.edu, Lijian Lu, Hanqin Zhang

We consider inventory replenishment policy and common component allocation rule for assemble-to-order (ATO) systems with non-identical leadtimes. We propose a policy and show that such policy is optimal under a certain condition. The policy is asymptotically optimal when the condition fails. We also present comparative statics and show that some commonly used heuristic policies can lead to significant optimality loss.

3 - Approximation Algorithms for Capacity Expansion Problems

Huanan Zhang, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, zhanghn@umich.edu, Xiuli Chao, Cong Shi

We consider a stochastic capacity expansion problem with deterioration. The goal is to coordinate a sequence of expansion decisions to satisfy the demand for services with a minimum expected total maintenance, lost sale and purchasing cost. Given a general structure of demand and deterioration, the computation of optimal policy is usually intractable. We provide a polynomial time algorithm with a constant worst-case bound, and we extend the algorithm to problems with more general structures.

4 - Value of Information for the Partially Observed MDP and Partially Observed Markov Game

Yanling Chang, Georgia Institute of Technology, Atlanta, GA, United States of America, changyanling@gatech.edu, Alan Erera, Chelsea White III

We investigate the impact of varying state observation accuracy on the value function of the POMDP and POMG, extend key results for the POMDP to the POMG, and show that POMG value function changes due to changes in state observation accuracy can be quite varied and can include discontinuities.

■ TD20

Level 2 - Room 205D

Pricing Strategy and Models for Storable and Nonstorable Commodities

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Jim Shi, Assistant Professor, Georgia State University, 35 Broad Street, Altanta, GA, 30303, United States of America, shigsu@gmail.com

1 - Agricultural Supply Chain of Price-maker with a Case Study of Colombian Coffee

Jim Shi, Assistant Professor, Georgia State University, 35 Broad Street, Atlanta, GA, 30303, United States of America, jmshi@gsu.edu, Yao Zhao, Rose Karimi Kiwanuka

This study is motivated by an empirical study on Colombian coffee supply chain and investigates general agricultural products with price-maker. We develop optimal selling policies for price maker.

2 - Term Structure Price Model for Non-storable Commodities

Miha Troha, University of Oxford, Manor Road, Oxford, United Kingdom, troha@maths.ox.ac.uk, Raphael Hauser

In this paper we propose a term structure power price model that, in contrast to widely accepted no-arbitrage based approaches, accounts for non-storable nature of power. It belongs to a class of equilibrium game theoretic models. We start the paper by describing the problem and proving existence and uniqueness of its solution. We then propose an algorithm applicable for solving the problem and conclude with numerical results contrasted with the existing power price models.

3 - Endogenous Price Leadership in a Competition Supply Chain Comprising an OEM and its Competitive ODM

Baozhuang Niu, Assistant Professor, Sun Yat-Sen University, Lingnan College, No. 135, Xingangxi Road, Guangzhou, China, niubzh@mail.sysu.edu.cn, Yulan Wang, Pengfei Guo

We study three price competition games between an original equipment manufacturer (OEM) and an original design manufacturer (ODM). We investigate their endogenous price timing game. The ODM provides manufacturing service and competes with its OEM by selling self-branded products. We consider two markets: the ODM market and the OEM market.

4 - Supplier Selection and Order Quantity Allocation with Quantity Discounts and Price-Sensitive Demand

Hamza Adeinat, The Pennsylvania State University, 201 Old Main, University Park, State College, PA, 16802, United States of America, hma5104@psu.edu

A MINLP model is present for a replenishment problem that consists of a single buyer and multiple potential suppliers. Each supplier offers all-unit quantity discounts. The buyer is allowed to submit multiple orders to the selected suppliers during a repeating order cycle. The buyer's demand rate is price sensitive. The model finds the optimal number of orders and corresponding order quantities, and the optimal demand rate and selling price that maximizes the buyer's total profit per time unit.

■ TD21

Level 2 - Room 206

Clinical Decision Making

Sponsor: Health Applications

Sponsored Session

Chair: Vedat Verter, Prof, Desautels Faculty of Management, McGill University, 1001 Sherbrooke West, Montreal, H3A 1G5, Canada, vedat.verter@mcgill.ca

1 - Information Diffusion and Physician Learning: Evidence from the U.S. Department of Veterans Affairs

Vishal Ahuja, University of Chicago, United States of America, vahuja@chicagobooth.edu, John Birge, Min-Woong Sohn, Chad Syverson, Elbert Huang

We evaluate the changes in prescription patterns of an anti-diabetic medication during the time period when several health and safety warnings were issued related to the drug. We use the variation in the prescription patterns to study the diffusion of information and examine operational factors that promote physician learning. We employ a unique and large dataset of diabetic patients comprising of information on patient and organizational characteristics spanning five years.

2 - Experiences with a National Organ Policy Advisory Committee

Andrew Schaefer, Professor, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, schaefer@pitt.edu

I have spent the last two years serving on a national organ policy advisory committee. In this talk I give an informal description of my experience with the committee, and lessons I've learned from working with a committee with a diverse set of backgrounds. I conclude with thoughts on how OR/MS can influence policy makers in healthcare.

3 - Multi-criteria Location-allocation Modeling for the Primary Care System Network in Ontario

Vedat Verter, Prof, Desautels Faculty of Management, McGill University, 1001 Sherbrooke West, Montreal, H3A 1G5, Canada, vedat.verter@mcgill.ca, Michael Carter, Anna Graber

The primary care scheme of Ontario, Canada, involves five models of care currently being employed simultaneously. We present a multi-criteria model to plan the distribution and mix of primary care models, while incorporating accessibility, operating cost and quality of service.

■ TD22

Level 2 - Room 207

Health Care I: Screening

Contributed Session

Chair: Ang Li, Department of Industrial & Systems Engineering, Texas A&M University, College Station, United States of America, isela@tamu.edu

1 - Optimal Guidelines for Screening Mammography Based on Individual Risk Factors

Qingxia Kong, Assistant Professor, School of Business, Universidad Adolfo Ibañez, Av. Diagonal Las Torres 2700, 506C, Penalolen, Santiago, Chile, qingxia.kong@gmail.com, Susana Mondschein

Early diagnose of breast cancer can significantly improve the 5-year survival rate. The current guidelines recommend one mammography each year for all women over 40 years old, independently of their health status. In this paper, we propose a stochastic dynamic programming model based on personalized data, including age, mammography history, health status and personal risk factors to determine the optimal mammography screening guidelines.

2 - Simulation Modeling to Investigate Risk-based Screening for Early Diagnosis of Breast Cancer

Mucahit Cevik, University of Wisconsin–Madison, 3233 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu, Oguzhan Alagoz

We aim to investigate the potential effects of risk-based screening in breast cancer outcomes by using a previously validated simulation model, University of Wisconsin Breast Cancer Simulation Model (UWBCS). We integrated individual risk factors including family history, hormonal replacement therapy (HRT) usage, body mass index (BMI), and breast density into the UWBCS and tested several risk-based screening strategies.

3 - Cost-effectiveness Analysis of Breast Cancer Screening Policies for the Canadian Population

Yasin Gocgun, Postdoctoral fellow, University of Toronto, 40 St. George St., Bahen Centre, 8145, Toronto, ON, Canada, gocgun@mie.utoronto.ca, Anthony Miller, Andrew Jardine, Jeffrey Hoch, Dragan Banjevic, Neil Montgomery, Sharareh Taghipour, Bart Harvey

We study the cost-effectiveness of breast cancer screening policies applied to different age-based risk-group subpopulations of women in Canada. Considering both screening and treatment phases of breast cancer, we model breast cancer progression as a multi-state Markov process. Using simulation, we perform a cost-effectiveness analysis and compare cancer screening policies under a variety of scenarios.

4 - Evaluating Outcomes of Screening for Lung Cancer with Computerized Tomography and Biomarkers

Ayca Erdogan, Stanford University, 1201 Welch Road, Room P060, Stanford, CA, 94305, United States of America, serdogan@stanford.edu, Sylvia Plevritis

We investigate the health and economic outcomes of screening for lung cancer with computerized tomography (CT) with a data driven microsimulation model. The model simulates individuals' lung cancer progression both in the absence of screening and with screening intervention. We then introduce hypothetical biomarkers into the screening process and study the impact on the outcomes.

5 - An Optimization Algorithm for Cranial Vault Remodeling Surgery

Ricardo Fukasawa, Associate Professor, University of Waterloo, 2 00 University Avenue West, Waterloo, N2L3G1, Canada, rfukasaw@math.uwaterloo.ca, James Drake, David Qian, Nikoo Saber, Jochen Konemann

Cranial vault remodeling is a surgical procedure applied to the skull of infants who suffer from craniosynostosis - a condition where soft bones of the skull prematurely fuse and facial deformities ensue. Besides aesthetics, the condition presents serious health risks. We propose an optimization approach to determine the locations of incisions that need to be performed during this surgery. The resulting algorithm runs in seconds and is expected to improve current surgical procedures.

■ TD23

Level 2 - Room 208A

Assortment and Price Optimization

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Paat Rusmevichientong, University of Southern California, Los Angeles, United States of America, rusmevic@marshall.usc.edu

Co-Chair: Huseyin Topaloglu, Cornell University, Frank H T Rhodes Hall, Ithaca, NY, 14853, United States of America, ht88@cornell.edu

1 - Assortment Optimization in Response to New Product Introductions in Grocery Retail

Ying Liu, New York University, 44 West Fourth Street, New York, NY, United States of America, yliu2@stern.nyu.edu, Srikanth Jagabathula, Andrew Vakhutinsky

We consider the problem of assortment optimization when there are new product introductions. Solving this problem requires addressing two main challenges: (a) predicting demand for new and existing items in response to the new product introduction, and (b) finding the optimal assortment in response to the demand predictions. We propose a new approach to predicting demand and an associated algorithm for assortment optimization. We report results on real-world supermarket transaction logs.

2 - A Greedy Algorithm for Assortment Optimization in the Two-Level Nested Logit Model

Guang Li, USC, Marshall School of Business, Los Angeles, United States of America, guang.li.2016@marshall.usc.edu, Paat Rusmevichientong

We consider the assortment optimization problem under the classical two-level nested logit model. We establish a necessary and sufficient condition for the optimal assortment, and use this optimality condition to develop a simple greedy algorithm that iteratively removes at most one product from each nest, until the optimality condition is satisfied.

3 - Assortment Optimization under the Multi-level Nested Logit Model

Paat Rusmevichientong, University of Southern California, Los Angeles, United States of America, rusmevic@marshall.usc.edu, Guang Li, Huseyin Topaloglu

We consider assortment optimization problems under the multi-level nested logit model. We show that the assortment optimization problem under this choice model can be solved in O(d n log n) operations, where d is the number of levels in the choice tree and n is the total number of products.

■ TD24

Level 2 - Room 208B

Demand Uncertainty and Pricing in Freight Transportation

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Parijat Dube, IBM, Yorktown Heights, NY, United States of America, pdube@us.ibm.com

1 - Mathematical Models for Transportation Lane Aggregation and Short Haul Lane Pricing

Qi Yuan, Supply Chain Research Analyst, Niagara Bottling, 10312 Sparkling Dr. Unit 1, Rancho Cucamonga, CA, 91730, United States of America, freestander@gmail.com, Xiaoyan Zhu, Ryan Kieczykowski, Bhaskar Tatke

To solve the problem of customers' demand variability in transportation lanes, we developed an innovative model to aggregate the lanes using cluster-based method. We also proposed an improved pricing model to guarantee fair pricing on short haul lanes. As a result, the spot loads are greatly reduced due to decreased variability and carriers are also willing to reserve more consistent capacity for the shipping company, which in turn increases the customer service level.

2 - Consolidation and Coordination of Intermodal Freight Transport

Wouter van Heeswijk, PhD Student, Twente University, Hallenweg 17, Enschede, 7522 NH, Netherlands, w.j.a.vanheeswijk@utwente.nl

We study the potential of freight consolidation in an intermodal transportation environment, comprising road-, railroad- and barge transport. Relevant aspects of this subject are the pre-selection of requests that could be consolidated, waiting policies, and pricing schemes for shared loads. We develop a planning algorithm, aimed at efficient and cooperative freight transport. The performance of this algorithm is tested on real data from a Dutch logistic service provider.

3 - Carrier Capacity Procurement and Transportation Cost under Demand Uncertainty
Parijat Dube, IBM, Yorktown Heights, NY, United States of America, pdube@us.ibm.com

Customers engaging in long-term freight transportation contracts with forwarders do not have accurate estimates of demand they will foresee. Demand is often loosely known as expected demand over some aggregate time interval. Forwarders need to account for the uncertainty in freight demand over the contract period when procuring capacity from carriers. We develop models for demand over contract period and use these to study capacity procurement and transportation cost for the forwarders.

■ TD25

Level 2 - Room 208C

Mechanism Design

Cluster: Auctions

Invited Session

Chair: Brian Baisa, Amherst College, Amherst, MA, United States of America, bhbaisa@gmail.com

1 - Optimal Internet Auctions with Costly Communication
Yuqian Li, Duke University, Durham, NC, United States of America, yuqian@cs.duke.edu, Vincent Conitzer

We propose an explicit cost model that is inspired by single-item Internet auctions, such as those taking place on auction sites (eBay) or via informal communication (craigslist, mailing lists). A nonzero bid comes at a cost to both the seller and the bidder, and the seller can send broadcast queries at a cost. We consider multi-round Vickrey auctions (MVAs) in this context, in which the seller runs multiple Vickrey auctions, with decreasing reserve prices.

2 - Auction Design Without Quasilinear Preferences
Brian Baisa, Amherst College, Amherst, MA, United States of America, bhbaisa@gmail.com

I analyze auction design in a private value setting and remove the standard restriction that bidders' preferences are quasilinear. Instead, I only assume that bidders are risk averse and the good being sold is a normal good. This leads to qualitatively different solutions to the auction design problem. Specifically, the auctioneer should use randomization to better exploit features of bidder risk preferences. I show that allowing randomization will improve efficiency and increase revenues.

3 - Mechanism and Network Design with Loss-exposed Agents
Changrong Deng, Duke University, Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, changrong.deng@duke.edu, Alexandre Belloni, Sasa Pekec

A large number of networked agents compete for a single indivisible resource. Agents experience a loss if the resource is allocated in their proximity but not to them. Resource and loss values are privately held by the agents. In a large network, a no-allocation equilibrium with revenues higher than that of any mechanism that always allocates the resource could emerge. We provide optimal direct mechanisms when the resource value is public, and describe the revenue-maximizing network structures.

4 - Information Concentration in Common Value Environments
Mikhael Shor, University of Connecticut, Storrs, CT, United States of America, mike.shor@uconn.edu, Vladimir Mares

We consider how information concentration affects a seller's revenue in common value auctions. The common value is a function of n random variables partitioned among m <= n bidders. For each partition, the seller devises an optimal mechanism. We show that whenever the value function allows scalar sufficient statistics and a common regularity condition is satisfied, a coarser partition always reduces revenues. In particular, any merger or collusion among bidders reduces revenue.

■ TD26

Level 2 - Room 208D

Location Models III

Sponsor: Location Analysis

Sponsored Session

Chair: Zvi Drezner, Professor, California State University, Dept. of ISDS, Fullerton, CA, 92834, United States of America, zdrezner@fullerton.edu

1 - Lower Bounds on Line Location Problems via Demand Regions
Robert Schieweck, University of Goettingen, Lotzestr. 16-18, Goettingen, 37083, Germany, r.schieweck@math.uni-goettingen.de, Anita Schoebel, Jack Brimberg

We generalize the classical model of locating p lines in the plane in order to minimize the sum of norm distances to some demand points to be able to deal with demand regions of a certain kind. Algorithms to solve this problem to optimality are given. This yields lower bounds on the classical problem which can then be used in a branch-and-bound framework. For the special case of p parallel lines we present incidence criteria and an efficient algorithm.

2 - Network Models and Biproportional Apportionment for Fair Seat Allocation in the UK Elections
Kerem Akartunali, Strathclyde Business School, Dept. of Management Science, 40 George Street, Glasgow, G1 1QE, United Kingdom, kerem.akartunali@strath.ac.uk, Philip Knight

Allocating seats in an election is a socially interesting problem that can be modelled using networks, for which we propose a wide choice of objective functions and allocation schemes. Then, we discuss biproportional apportionment and its application to single seat constituencies. In particular, we propose methods that can be tuned to meet public's definition of "fairness". Using data from the 2010 UK elections, we study a variety of models, and address conditions of existence and uniqueness.

3 - The Fortified Weiszfeld Algorithm for Solving the Weber Problem
Zvi Drezner, Professor, California State University, Dept. of ISDS, Fullerton, CA, 92834, United States of America, zdrezner@fullerton.edu

An improved Weiszfeld algorithm, termed the fortified Weiszfeld algorithm, for the solution of the single facility Weber problem with Euclidean distances is proposed. The new approach is based on a parabolic approximation of the objective function and testing demand points for optimality. Computational experiments show the superiority of the fortified approach over the original Weiszfeld algorithm.

■ TD27

Level 2 - Room 209A

Inventory Management: Production and Scheduling

Contributed Session

Chair: Mohsen Elhafsi, Professor, University of California, School of Business Administration, Riverside, CA, 92521, United States of America, mohsen.elhafsi@ucr.edu

1 - Performance Measures in Serial Supply Systems with Stochastic Demands for Intermediate Parts
Min Wang, Drexel University, 101 N 33rd St., Philadelphia, PA, 19104, United States of America, mw638@drexel.edu

We investigate a multi-stage serial supply system with stochastic demands for end products as well as the intermediate components. We analyze the performance measures of the system under a base-stock policy with rationing. We also discuss other heuristic policies and numerically compare their performances

2 - Myopic Replenishment Policies for Inventory Systems with Lost Sales
Marco Bijvank, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, mbijvank@rsm.nl

We study the control of a single item inventory system with fixed order cost where excess demand is lost. It is intractable to find an optimal replenishment policy. We propose a myopic policy that can be used when demand is either stationary or non-stationary, and illustrate its superior performance.

3 - Inventory Management in Batch Process with Flexible Recipe
Long He, University of California, Berkeley, 1117 Etcheverry Hall, Berkeley, CA, United States of America, longhe@berkeley.edu, Z. Max Shen, Simin Huang

We study the inventory investment, recipe selection and resource allocation decisions in batch process systems with flexible recipe. A two-stage stochastic mixed integer program formulation is developed for each period. Moreover, the system updates its inventory investment decisions based on new demand data from previous periods by a simulation-based approach. Benefits of implementing flexible recipe over traditional fixed recipe are investigated in the numerical studies.

4 - A Horizon/Product Decomposition Algorithm for Multi-level Capacity Constrained Lot Sizing Problem
Xue Lu, PhD Student, London Business School, Management Science and Operations, 26 Sussex Pl, London, NW1 4PT, United Kingdom, xlu.phd2009@london.edu, Zeger Degraeve

Multi-level capacity constrained lot sizing has high application value, but solving the problem to optimality remains daunting.We propose a Horizon/Product Decomposition algorithm which decomposes the time horizon into contiguous short time horizons and the multi-level product structure into a set of sub structures.Rigorous computational results show that our algorithm provides a tighter lower bound than all the existing model reformulations, and also Cplex by 30% within the same computing time.

5 - Optimal Control of an Inventory System with Stochastic and Independent Leadtimes
Mohsen Elhafsi, Professor, University of California, School of Business Administration, Riverside, CA, 92521, United States of America, mohsen.elhafsi@ucr.edu, Saif Benjaafar

We consider an inventory system with Poisson demand and exponentially distributed replenishment Leadtimes. Inventory is stocked ahead of demand. Demand that cannot be immediately fulfilled is backordered. The system is continuously reviewed and a replenishment order for one or more units can be placed at any time. There can be at most m units ordered, at any time, but not yet received. We use a MDP framework to formulate the problem and characterize the structure of the optimal control policy.

■ TD28

Level 2 - Room 209B

Advances in Cloud Computing

Cluster: Cloud Computing

Invited Session

Chair: Ton Dieker, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, United States of America, ton.dieker@isye.gatech.edu

1 - Capacity Reservation Policies in Cloud Computing Marketplaces
Aaron Yan, Gravitant, Inc., 11940 Jollyville Rd. Suite 325-N, Austin, TX, 78759, United States of America, aaron.yan@gravitant.com, Ilyas Iyoob, Ton Dieker

Many IT organizations now choose to go to the Cloud for their computing needs. While Cloud computing allows practically infinite scaling of capacity based on demand, such "on-demand" capacity is relatively expensive. Instead, IT organizations may choose to reserve some capacity for some portion of their demand and then resort to "on-demand" capacity only for unsatisfied demand. In this paper, we define the optimal capacity reservation policy that minimizes cost subject to demand variability.

2 - IP Column Generation for a Service Deployment Problem
Anders N. Gullhav, PhD Candidate, NTNU, Dept. of Industrial Economics and Tech., Trondheim, 7491, Norway, anders.gullhav@iot.ntnu.no, Bjorn Nygreen

Providers of cloud software services are concerned about being cost-efficient in their service delivery, while providing a quality of service in accordance with the end-users' requirements. We present an IP column generation formulation for a service deployment problem considering response time and availability requirements and the operational costs of the service provider. Our results show that a column generation approach provides better solutions more quickly than a direct formulation.

3 - Strategic Pricing and Capacity Planning in Cloud Computing Markets
Manuel Nunez, Associate Professor, University of Connecticut, 2100 Hillside Road, Storrs, CT, 06269, United States of America, mnunez@business.uconn.edu, Linna Du, Xue Bai

We develop pricing and capacity planning models for a cloud provider considering trade-offs between service reliability and capacity utilization. The provider's objectives are to optimally allocate resources, price different types of cloud services, and extract the maximum revenue from the market. We analyze two basic types of cloud services: contract and on-demand; and propose hybrid systems in which the two basic services simultaneously co-exist.

■ TD29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - IBM - Expert Tips and Tricks for Using CPLEX Optimization Studio
Ferenc Katai, IBM ILOG CPLEX Optimization Studio Product Manager, IBM Software Group, Industry Solutions, ILOG, Sophia-Antipolis, France, ferenc.katai@fr.ibm.com

Learn about the latest innovations in CPLEX Optimization Studio including options for distributed computing. Learn how to make best use of this technology with expert tips and tricks provided by the CPLEX Optimization Studio team.

2 - Maximal Software, Inc. - Deploying Optimization Models on Servers and Mobile Platforms Using MPL OptiMax
Bjarni Kristjansson, Maximal Software, Inc., 2111 Wilson Boulevard, Suite 700, Arlington, VA, 22201, United States of America, bjarni@maximalsoftware.com

The IT industry is currently undergoing a major shift, away from traditional standalone applications, to new platforms such as servers, clouds, tablet, and mobile phones. In this software tutorial, we will demonstrate a new server-based version of the MPL OptiMax Component Library, which makes implementing real-world optimization applications a relatively quick and easy process. We will take you through all the steps of implementing optimization projects, including formulating the model, integrating it seamlessly with data in different formats, and then finally deploying the project on a server for servicing both web and mobile clients, using standard programming languages, such as CSharp, Visual Basic, C/C++, or Python.

■ TD30

Level 2 - Room 210B

Optimization with Metaheuristics

Contributed Session

Chair: Rasool Pourghaderi, Islamic Azad University, Oloom Tahghighat Branch,Tehran, Iran, Ponak Squire, Siminbolivar Ave., Azad Uni, Tehran, Iran, rp.pourghaderi@gmail.com

1 - The Job Shop Scheduling Problem Solved with the Travel Salesman Problem and Genetic Algorithms
Eva Hernandez, Dr., Hidalgo State University, José Lugo Guerrero 200 Col. Cuauhtémod, Pachuca, 42020, Mexico, evah@uaeh.edu.mx, Joselito Medina, Juan Carlos Seck Tuoh Mora, Gustavo Anaya

We propose a method for solving the Travel Salesman Problem (TSP) solved with Genetic Algorithms, and then the solution of the TSP is used to solve the Job Shop Scheduling Problem (JSSP), an NP-Hard Problem, in a considerable computing time. Using this method we solved and compared different classical JSSP.

2 - Pareto Uncertainty Index in Multi-Objective Genetic Algorithm: An Application to GEP
Saltuk Selcuklu, PhD Student, Rutgers University, 3931 BPO Way, Rutgers University, Piscataway, NJ, 08854, United States of America, bugrasel@gmail.com, Frank Felder, David Coit, Mark Rodgers

The Generation Expansion Planning problem is a stochastic multi-objective optimization problem. For multi-objective optimization problems, a common solution methodology is to determine a Pareto optimal set. However, the Pareto optimal set gives deterministic results. Pareto Uncertainty Index can reflect the stochastic nature of the problem to the Pareto set. This study aims to use PUI as a Pareto ranking approach in Multi-Objective Genetic Algorithm. The proposed method is applied to the GEP.

3 - Layout Problems with Departments with Heterogeneous Area Constraints
Junjae Chae, Associate Professor, Korea Aerospace University, 76 Hanggongdaehang-ro, Deogyang-gu, Goyang-City, Korea, Republic of, jchae@kau.ac.kr, Amelia Regan

Some facility layout problems consider both the dimension and location of departments as decision variables while others assume that departmental dimensions are fixed a priori. This study explores the way to design the layout of departments in cases where we mix both fixed and variable dimensions.

4 - Energy Efficient Computation of Data Fusion in Wireless Sensor Networks

Rasool Pourghaderi, Islamic Azad University, Oloom tahghighat Branch, Tehran, Iran, Ponak Squire, siminbolivar Ave., Azad Uni, Tehran, Iran, rp.pourghaderi@gmail.com, Majid Mohammadi, Ahmad Reza Pourghaderi

Energy efficient communication is a universal issue in Wireless Sensor Networks (WSNs). We propose a meta-heuristic approach for cluster head selection and formation of clusters among the Sensor nodes which are deployed randomly. The proposed approach can significantly improve the network compared to traditional methods.

■ TD31

Level 2 - Room 211A

Advances in Financial Engineering

Sponsor: Financial Services

Sponsored Session

Chair: James Primbs, Associate Professor, University of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, jap120030@utdallas.edu

1 - Optimal Hedging of Path-dependent Basket Options: Extension to First Passage Time Structural Models

Yuji Yamada, Professor, University of Tsukuba, 3-29-1 Otsuka, Bunkyo-ku, Tokyo, 112-0012, Japan, yuji@gssm.otsuka.tsukuba.ac.jp

In this paper, we extend our previously proposed optimal hedging technique to path-dependent basket options using arbitrarily smooth payoff functions of individual options. We show that the sum of individual option values takes an optimal trajectory to minimize the mean square error under the risk neutral measure. We apply our methodology to the first passage time structural model, where a company with default risk possesses multiple projects/assets, and evaluate its individual equity values.

2 - Progressive Hedging Approach for the Stochastic Index Tracking Problem

Roy Kwon, Associate Professor, University of Toronto, 5 King's College Rd., Toronto, On, M5S 3G8, Canada, rkwon@mie.utoronto.ca, Dexter Wu

We formulate the problem of following a benchmark index as a two sage stochastic mixed integer program. The model incorporates a wide range of trading constraints. A progressive hedging heuristic is presented that is shown to generate optimal or near optimal solutions is reasnable time. Comparisons are made with methods such as dual decomposition.

3 - Interaction between Financial Risk Measures and Machine Learning Methods

Jun-ya Gotoh, Associate Professor, Chuo university, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, Japan, jgoto@indsys.chuo-u.ac.jp, Rei Yamamoto, Akiko Takeda

Employing the coherent measures of risk, we develop a generalized criterion for classification methods. They includes existing criteria, such as the margin maximization and nu-SVM, as special cases. Although the new criterion is first formulated as a nonconvex optimization, it results in a convex optimization by employing the nonnegative l1-regularization. Numerical examples demonstrate how the developed methods work for bond rating.

4 - Accounting for Risk Measure Ambiguity when Optimizing Financial Positions

Jonathan Li, Assistant Professor, Telfer School of Management, University of Ottawa, Ottawa, Canada, jonathan.li@telfer.uottawa.ca, Erick Delage

While many risk measures have been proposed in the past, it is still a great challenge today to select a risk measure that faithfully represents a decision maker's true risk attitude. In this work, we present new robust forms of measures that account precisely for the risk preference of a decision maker when comparing and optimizing financial positions. Such measures can be evaluated and optimized through solving linear programs. Examples of portfolio optimization are provided.

■ TD32

Level 2 - Room 211B

Models of Innovation Management

Sponsor: Technology Management

Sponsored Session

Chair: Debasish N. Mallick, Associate Professor, University of St. Thomas, Opus College of Business, 1000 LaSalle Ave. #SCH 435, Minneapolis, MN, 55403, United States of America, dnmallick@stthomas.edu

1 - New Service Development and Value Creation in E-retailing

Kingshuk Sinha, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Gregory Heim, Anto (John) Verghese, Howard Hao-Chun Chuang

Technology-enabled new service development is investigated using multi-year panel data on e-retailers. A theory driven empirical analysis is conducted to assess how e-retailer's operating characteristics drive e-retailer survival or death, scaling up of operations, and business value. Survival-conditional effects of efficiency, lock-in, novelty, and complementarities on several performance metrics are examined.

2 - Dynamic or Persistent? How to Spend on R&D

Christophe Pennetier, PhD Student, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, cpennetier@gmail.com, Karan Girotra, Jurgen Mihm

We examine the effect of the variability in R&D investments on a firm's operational performance. We hypothesize that firms that increase or decrease R&D investments in a short period of time, reduce the effectiveness of these investments irrespective of the absolute level of the investment.

3 - Closed-loop Supply Chain Models in Manufacturing-Remanufacturing Operations

Tianqin Shi, University of Illnois at Urbana Champaign, 1206 S. Sixth St., 350 Wohlers Hall, Champaign, IL, 61820, United States of America, tshi3@illinois.edu, Dilip Chhajed, Zhixi Wan

While a centralized firm is more willing to design a product for re-manufacturability, in a firm where different divisions do the remanufacturing and manufacturing, the manufacturing division may need incentive to do so. Using a stylized model we analyze this problem and propose incentive systems to encourage the manufacturer to design the product that can be re-manufactured.

4 - The Transformation of Innovation Ecosystems in Global Metropolitan Areas: A Data-Driven Perspective

Rahul Basole, Associate Professor, Georgia Institute of Technology, 85 Fifth St., NW, Atlanta, GA, 30332, United States of America, basole@gatech.edu, Martha Russell, Jukka Huhtamaki, Kaisa Still, Neil Rubens

This study provides a comparative, multiscopic study of the structural transformation of innovation ecosystems in select major U.S. and worldwide metropolitan areas from 1990-2012. Our results reveal distinct patterns of ecosystem formation, growth, and evolution. We complement our findings using an interactive network visualization approach.

■ TD33

Level 2 - Room 211C

Regulating Hazardous Materials Transportation

Cluster: Homeland Security/Defense

Invited Session

Chair: Young-Jun Son, Professor, The University of Arizona, Engineering Blg #20, Room #111, Systems, The University of Arizona, Tucson, AZ, 85721, United States of America, son@sie.arizona.edu

Co-Chair: Changhyun Kwon, Assistant Professor, University at Buffalo, 318 Bell Hall, University at Buffalo, Buffalo, NY, 14260, United States of America, chkwon@buffalo.edu

1 - Dynamic Dual-toll Pricing with Delayed Departure Times in Hazmat Transportation

Tolou Esfandeh, Research Assistant, SUNY-University at Buffalo, 339A Bell Hall, Department of Industrial and Systems Eng, Buffalo, NY, 14051, United States of America, tolouesf@buffalo.edu, Changhyun Kwon, Rajan Batta

In this talk, we develop and analyze a time dependent dual toll-pricing model to mitigate the risk of hazmat transportation.Our risk measure applies time-varying link traffic flow to indicate the accident consequences. The model permits trip makers to respond differently either by choosing the least cost path or by delaying the departure time . We formulate the model as a dynamic mathematical problem and propose a solution method.

2 - Agent-based Simulation for Dual Toll Pricing of Hazardous Material Transportation

Sojung Kim, University of Arizona, Tucson, AZ, 85719, United States of America, sojungkim@email.arizona.edu, Young-Jun Son, Mungle Santosh

The goal of dual toll pricing policy is to mitigate a risk of hazardous materials (hazmat) transportation via deterring hazmat traffic flow from regular traffic. This paper aims at developing a simulation model for the dual toll pricing policy under a realistic road network environment, where an extended BDI modeling framework is employed to mimic the driver's decision making behaviors in a great detail. The proposed approach is successfully demonstrated for the traffic data of Albany, NY.

3 - Combined Toll Pricing and Network Design for Hazardous Materials Transportation

Masoumeh Taslimi, Research Assistant, University at Buffalo, 339-A, Bell Hall, Department of Industrial and Systems Eng, Buffalo, NY, 14051, United States of America, masoumeh@buffalo.edu, Changhyun Kwon, Rajan Batta

Hazardous materials transport remains regulated due to its potential risk to health, safety, and environment. We investigate an application of the combination of toll pricing policy and network design and their effects on the carriers' route choices. We present a bi-level optimization problem to minimize the associated hazmat transport risk.

4 - Advanced Risk Measures Applied in Hazardous Materials Routing

Iakovos Toumazis, PhD Student, University at Buffalo, 339A Bell Hall, University at Buffalo, Buffalo, NY, 14260, United States of America, iakovost@buffalo.edu, Changhyun Kwon

New classes of risk measures are introduced and analyzed for local route planning in hazardous materials transportation. In particular, value-at-risk, conditional value-at-risk, and a general class of spectral risk measures are considered for risk-averse and flexible routing methods. Tractable computational methods are suggested.

■ TD34

Level 2 - Room 211D

Agent-based Modeling and Simulation – Overview and Tutorial

Sponsor: Simulation Society

Sponsored Session

Chair: Charles Macal, Senior Systems Engineer, Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221 - DIS, Argonne, IL, 60439, United States of America, macal@anl.gov

1 - Agent-based Modeling and Simulation – Overview and Tutorial

Charles Macal, Senior Systems Engineer, Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221 - DIS, Argonne, IL, 60439, United States of America, macal@anl.gov

Agent-based modeling and simulation (ABMS) is a new approach to modeling systems comprised of autonomous, interacting agents. Applications are growing rapidly in fields ranging from modeling the stock market to predicting the spread of epidemics. Complex adaptive systems, emergent behavior, and self-organization are a few of the notions from ABMS. This tutorial covers the foundations of ABMS, development toolkits and methods, practical aspects, and the relationship of ABMS to conventional OR.

■ TD35

Level 2 - Room 212A

Advertising and Commerce in the New Mobile Economy

Sponsor: E-Business

Sponsored Session

Chair: Sang Pil Han, Assistant Professor, City University of Hong Kong, Tat Chee Ave., Kowloon, Hong Kong - PRC, sangphan@cityu.edu.hk

1 - Effectiveness of Location-based Advertising: A Randomized Field Experiment Comparing PC with Mobile

Dominik Molitor, LMU Munich, Geschwister-Scholl-Platz 1, Munich, Germany, molitor@bwl.lmu.de, Philipp Reichhart, Martin Spann, Anindya Ghose

In this study, we examine the interplay between interplay between display rank, geographical distance and promotional discounts on smartphones and PCs. Using data from a large-scale randomized field experiment involving location-based promotions for smartphones and PCs, we are able to show that users' choices are negatively affected by the interplay between information on geographical distance and the display rank of the offer on the screen.

2 - Which Creative Works and Where: Examining the Differences between Mobile, Tablet, and PC Advertising

Djon Kleine, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, djonkleine@gmail.com, Ting Li, Sang Pil Han

This study examines the effectiveness of advertising across different digital channels and explains what advertisement characteristics account for these differences. Using data from a field experiment we compare the ad performance. In this study we examine (1) the effectiveness of mobile advertising on the creative-level; (2) how visitor's subsequent on-site behaviour differ across digital channels; (3) what accounts for the performance and behavioural differences.

3 - Mobile Commerce in the New Tablet Economy

Sang Pil Han, Assistant Professor, City University of Hong Kong, Tat Chee Ave., Kowloon, Hong Kong - PRC, sangphan@cityu.edu.hk, Anindya Ghose, Kaiquan Xu

This paper quantifies the economic contribution of tablets in ecommerce and m-commerce markets. We use an archival data from the largest online and mobile ecommerce website in China and exploit a quasi-natural experiment. Results show that the introduction of the tablet enhances the overall growth of ecommerce markets with its annualized impact of US$4.88 billion. The tablet channel is a substitute for the existing PC channel and a complement for the smartphone channel.

■ TD36

Level 2 - Room 212B

Health Care XI: Effective Therapy and Treatment

Contributed Session

Chair: Pei-Fang Tsai, Assistant Professor, Department of Industiral Engineering and Management, National Taipei University of Technology, PO Box 32-26, Taipei, 106, Taiwan - ROC, p.jennifer.tsai@gmail.com

1 - An Investigation of the Interplay Effect of Intensity Modulated Proton Therapy for Lung Tumors

Laleh Kardar, Ph.D. Candidate, University of Houston, Department of Industrial Engineering, W228 Engineering Building 2, Houston, TX, 77081, United States of America, lkardar@uh.edu, Wenhua Cao, Gino Lim

In this study, the 4D dynamic dose was calculated by simulating the intensity modulated proton therapy (IMPT) delivery process along with the moving lung tumor target described by 4D CTs. Timestamps of switching irradiation fields, proton energies, scanning spots were linked to patient respiratory cycles. The impact of interplay effects for IMPT lung treatment plans was evaluated and new "repainting" schemes for mitigating the interplay effects was also explored.

2 - Design and Scheduling of Proton Therapy Treatment Centers

Stuart Price, University of Maryland, 8201 16th Street, Apt. 1002, Silver Spring, MD, 20910, United States of America, sprice@rhsmith.umd.edu, Bruce Golden, Edward Wasil, Hao Zhang

Proton therapy is a promising treatment to fight cancer. Due to the high cost of construction, there are very few treatment centers. We construct a simulation to compare layouts for proton therapy treatment centers. After comparing patient throughput, we examine alternative schedules and their effect on patient wait times and facility utilization.

3 - Dynamic Multi-objective Radiation Therapy

Arkajyoti Roy, Purdue University, 315 N. Grant Ave., West Lafayette, IN, 47906, United States of America, roya@purdue.edu, Omid Nohadani

Traditional radiation therapy optimization addresses competing clinical objectives through allocation of weights based on initial information. However, over the course of the treatment, spatiotemporal changes in patient anatomy lead to advantageous or at times disadvantageous geometries. We present a dynamically weighted multi-objective approach that exploits the anatomical variations and sizably improves treatment quality.

4 - Using Discrete-event Simulation in Capacity Planning for an Outpatient Physical Therapy Room

Pei-Fang Tsai, Assistant Professor, Department of Industiral Engineering and Management, National Taipei University of Technology, PO Box 32-26, Taipei, 106, Taiwan - ROC, p.jennifer.tsai@gmail.com, Kai-Ying Chen, Chi-Lun Rau, Sheau-Farn Liang

A discrete-event simulation model was constructed to study the dynamics of patient mixes with realistic treatment plans, and to estimate the practical capacity of the physical therapy room. The changes in time-related and space-related performance measurements were used to evaluate the impact of various capacity strategies. The average waiting time per patient could be reduced by 45% when pooling 2 therapists. Moreover, new patients should be given priority to reduce waiting time.

■ TD37

Level 2 - Room 213A

Periodic Scheduling and Applications

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Jeffrey Herrmann, Associate Professor, University of Maryland-College Park, ent of Mechanical Engineering, College Park, MD, 20742, United States of America, jwh2@isr.umd.edu

1 - Iterated Beam Search Solution for the Combined Level Scheduling and Car Sequencing Problem

Mesut Yavuz, Associate Professor, Shenandoah University, Byrd School of Business, 1460 University Drive, Winchester, VA, 22601, United States of America, myavuz@su.edu

Level scheduling is an important problem in just-in-time manufacturing, aiming to fairly allocate time on a shared production line to competing product variants. In automotive assembly, scheduling product variants is subject to additional option constraints. In this talk we present a novel Iterated Beam Search algorithm to solve the Combined Level Scheduling and Car Sequencing Problem. We also discuss the method's application to the Car Sequencing Problem alone.

2 - Balancing Perfectly Periodic Service Schedules Quickly with Aggregation

Jeffrey Herrmann, Associate Professor, University of Maryland-College Park, ent of Mechanical Engineering, College Park, MD, 20742, United States of America, jwh2@isr.umd.edu

Scheduling periodic services that have different period lengths seeks a schedule in which the workload is nearly the same in every time unit. This talk will discuss a new aggregation approach that separates the problem into subproblems for each period length, forms aggregate services, schedules these, and then creates a solution to the original instance. Computational experiments show that using aggregation generates high-quality solutions and reduces computational effort.

3 - Scheduling More Crash Tests on Fewer Vehicles

Yuhui Shi, University of Michigan, 1205 Beal Road, Ann Arbor, MI, United States of America, yuhuishi@umich.edu, Marina Epelman, Amy Cohn, Daniel Reich, Erica Klampfl

Ford's Safety organization performs crash tests on prototype vehicles at multiple planning phases of each new vehicle program. Improvements in scheduling can reduce the number of vehicles crashed, resulting in major savings. Manual planning each crash schedule and coordinating with all the other prototype vehicle users is extremely time intensive. We are developing an automated system that both minimizes the resources needed and significantly reduces the time engineers spend planning.

■ TD38

Level 2 - Room 213B

Supply Chain: Operations Management

Contributed Session

Chair: Ismail Civelek, Assistant Professor, Western Kentucky University, 1906 College Heights Blvd., Grise Hall #207, Bowling Green, KY, 42101, United States of America, ismail.civelek@wku.edu

1 - Robust Production Plan for Products with Stochastic Seasonal Demand and Random Yield Rate

Kai-Chuan Yang, University of California, Berkeley, 4141 Etcheverry Hall, Mail Code 1777, Berkeley, United States of America, kcyang@gmail.com, Candace Yano

Manufacturers who produce multiple products with stochastic seasonal demand under capacity constraints often face challenges in building inventory in anticipation of demand in the high season. The problem is more challenging for new products with uncertain yields and demands. We develop analytical models as the basis for devising a robust production plan, and report numerical results on the performance of the proposed plan.

2 - Supply Chain with Competing Retailers

Ruo Du, Southwestern University of Finance and Economics, 555 Liutai Road ,Wenjiang, Chengdu, 611130, China, ruodu7@gmail.com

This paper focuses on a supply chain with correlated retailers using a Bertrand competition for a differentiated product. We are interested in how the extent of the competition and the changes of the whole market would affect the supply chain decisions. Numerical examples are provided in order to demonstrate the effects of the nature of competition on the decentralized supply chain decisions and the coordination mechanisms under consideration.

3 - Impacts of Transportation Cost and Exchange Rate Risk in Global Supply Chains

Ismail Civelek, Assistant Professor, Western Kentucky University, 1906 College Heights Blvd., Grise Hall #207, Bowling Green, KY, 42101, United States of America, ismail.civelek@wku.edu, Zubair Mohamed

Transportation costs and exchange rate risk have been significant factors in selection of suppliers in global supply chain management. In this study, we investigate the effects of both of these factors on a firm's strategic decisions on working with local or international suppliers. We develop an optimization model to analyze the impacts of transportation cost and exchange rate risks and show when local sourcing may be beneficial under certain conditions.

4 - Does a Store Brand Always Hurt the Manufacturer of a Competing National Brand?

Ruixia Shi, Assistant Professor, University of Richmond, Robins School of Business, Richmond, VA, 23173, United States of America, rshi@richmond.edu, Jun Zhang, Jun Ru

It is generally believed that store brands benefit retailers while they hurt national brand manufacturers. In this paper, we show that a store brand may benefit the manufacturer of a competing national brand under the retail fixed markup contract. The store brand may lessen the double marginalization problem of the supply chain for the national brand, but does it in an unconventional way. Our results explain many observations reported in empirical studies.

5 - Delivery Performance Improvement in Two-stage Supply Chain

Maxim Bushuev, Kent State University, Kent State University, Kent, United States of America, mbushuev@kent.edu

Strategies of supply chain delivery performance improvement are investigated. The performance is measured using a cost-based model which evaluates the expected penalty cost for early and late delivery. The effect of the width of the delivery window and penalty costs for early and late deliveries on the optimal position of the delivery window and the expected penalty cost are explored in general case. The effect of a mean and variance parameters of a normal delivery time distribution are revised.

■ TD39

Auditorium 3

Railway Service Planning and New Technology

Sponsor: Railway Applications

Sponsored Session

Chair: Samuel Sogin, Assistant Manager Service Scheduling, Union Pacific, 1400 Douglas Street, STOP 1120, Omaha, NE, 61801, United States of America, samsogin@gmail.com

1 - Composite Dispatching Rules to Schedule Passenger-coaches in Indian Railways

Balasubramanian Kanagasabapathi, Research Scientist, Infosys Limited, 44 Electronics City, Hosur Road, Bangalore, KA, 560100, India, kanagasabapathi_B@infosys.com, Manish Kumar, Santhosh Kumar Somarapu, Venkatesh G. Angirasa, K. Antony Arokia Durai Raj

We propose composite dispatching rules for scheduling passenger-coaches for Rajdhani services in Indian Railways; these are passenger services from different state capitals to the federal capital city of New Delhi. Effectiveness of several dispatching rules are compared with existing rules using percentage utilization and number of passenger-coaches.

2 - Development of a Feasibility Model for a High Speed Rail Line

Reinaldo C. Garcia, Associate Professor, Universidade de Brasilia (UnB), Industrial Engineering Department, Faculty of Technology, Brasilia, DF, 70910-900, Brazil, rcgar@yahoo.com, Aline Goulart

We have developed a model to determine the feasibility of a High-Speed Rail (HSR) line. Issues including the uncertainty of the demands and price elasticity are addressed, and the model is implemented for the HSR to be built in Brazil, connecting the cities of S„o Paulo and Rio de Janeiro.

3 - A Heuristic for the Driver Scheduling Problem in Passenger Rail Transportation

Dung-Ying Lin, National Cheng Kung University, 1 University Road, Transportation Management, Tainan City, Ch, 70101, Taiwan - ROC, dylin@mail.ncku.edu.tw, Pak Weng Leong

To solve the driver scheduling problem in a passenger railway transport system, we developed a two-stage heuristic. In the first stage, a search algorithm generates candidate duties that do not violate the contractual working rules. In the second stage, a selection heuristic efficiently selects duties to cover a published timetable. The proposed approach is applied to a company to verify its effectiveness. The promising results demonstrate that our method can solve real-world problems.

4 - The Delay Distribution
Samuel Sogin, Assistant Manager Service Scheduling, Union Pacific, 1400 Douglas Street, STOP 1120, Omaha, NE, 61801, United States of America, samsogin@gmail.com

Previous research has shown that single and double-track railways operate differently. One fundamental difference is the underlying delay distribution. A single-track line is likely to have a Weibull delay distribution, and a double-track line is likely to have an Exponential distribution. This study quantifies this transition by simulating shared corridors at various traffic densities at different double tracking percentages. These results will help plan for better on-time-performance.

■ TD40

Auditorium 2

(Process) Flexibility in Manufacturing and Computer Systems

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Yehua Wei, Massachusetts Institute of Technology, 60 Wadsworth Street, 17F, Cambridge, Ma, 02142, United States of America, y4wei@MIT.EDU

1 - Sparse Process Flexibility under Non-Homogenous Product Demands
Hoda Bidkhori, Massachusetts Institute of Technology, Cambridge, MA, 02139, United States of America, bidkhori@mit.edu, Yehua Wei, David Simchi-Levi

In this presentation, we study chaining and sparse process flexibilities under systems with non-homogenous plant and products. We find that for sparse flexibilities under non-homogenous system, traditional guidelines like constructing a long chain do not always work well. We provide a condition on when a collection of disjoint chains performs better than the long chain under non-homogenous system. Performance guarantees are also developed for various sparse flexibility designs.

2 - Queuing System Topologies with Limited Flexibility
Kuang Xu, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, kuangxu@mit.edu, John N. Tsitsiklis

We study a multi-server model where n flexible servers are connected to rn queues through a fixed connectivity graph, with average degree d. We show that as n tends to infinity, both a diminishing delay and a large capacity region are jointly achievable, even under limited flexibility (d << n): a family of random graphs are shown to stabilize all bounded admissible arrival rates, while simultaneously ensuring a diminishing queueing delay under a new class of matching-based scheduling algorithms.

3 - Robust Scheduling for Flexible Queueing Networks
Yuan Zhong, Columbia University, 560 Riverside Drive, New York, NY, 10027, United States of America, zhyu4118@gmail.com, Jean Walrand, Ramtin Pedarsani

We consider a general flexible queueing network with servers of overlapping capabilities, which include parallel server systems and open multiclass queueing networks. A scheduling policy decides how server capacities are allocated over time, and it is robust if it does not use knowledge of network parameters. We propose a gradient-descent like robust scheduling policy for general flexible networks, and discuss its convergence and delay properties. In addition, we also provide simulation results.

4 - Increasing Supply Chain Robustness through Process Flexibility and Strategic Inventory
He Wang, Massachusetts Institute of Technology, Cambridge, MA, United States of America, wanghe@mit.edu, David Simchi-Levi, Yehua Wei

This presentation discusses the combination of process flexibility and strategic inventory as an effective disruption mitigation strategy. For a manufacturer with multiple plants, we analyze K-chain flexibility designs in which each plant is capable of producing exactly K products. We find that 3-chain is significantly more robust than 2-chain when there is demand uncertainty. In an assembly system, we find that investment in process flexibility changes the optimal inventory placements.

■ TD41

Level 1 -101A

Managing Strategic Behavior In Service Systems

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Eren Cil, Assistant Professor, University of Oregon, 1208 University of Oregon, Eugene, OR, 97403-1208, United States of America, erencil@uoregon.edu

1 - Managing Service Systems Via Hidden Queues: The Role of Strategic Customer Behavior
Eren Cil, Assistant Professor, University of Oregon, 1208 University of Oregon, Eugene, OR, 97403-1208, United States of America, erencil@uoregon.edu

We consider a firm that can hide parts of its waiting lines as in touristic attractions. When the firm commits to a decision and informs customers about it, the firm hides a smaller part of its queue than it would do in a market with non-strategic customers. On the other hand, when customers do not know the exact decision of the firm, the firm hides its queue more aggressively as a response to strategic customer behavior. In fact, the firm may choose to hide its queue almost completely.

2 - Service Systems with Experience-based Anecdotal Reasoning Customers
Tingliang Huang, Assistant Professor, University College London, Gower Street, Department of Management Science & Innov, London, WC1E 6BT, United Kingdom, t.huang@ucl.ac.uk, Ying-Ju Chen

The existing queueing literature typically assumes that customers either perfectly know the expected waiting time or are able to form rational expectations about it. In contrast, in this paper we study canonical service models where customers do not have such full information or capability. We assume that customers can only rely on past experiences and anecdotal reasoning to make their joining or balking decisions.

3 - Sharing Equally: Managing Collaborative Consumption
Robert Hampshire, Heinz College, Carnegie Mellon University, Pittsburgh, PA, United States of America, hamp@cmu.edu, Ana Busic

The sharing economy is an emerging mode of resource allocation. An example is bike sharing. In a closed service system customers rent assets from a service station, and return them to another station after a random usage time. A management challenge is to ensure the proper balance of assets across the network of service stations. The current practice is to move assets by a fleet to rebalance the network. Our goal is to address the network imbalance with a control policy which induces balance.

4 - Cost Per Click Pricing for Display Advertising
Sami Najafi-Asadolahi, University of Toronto, Toronto, ON, Canada, sami.najafi@rotman.utoronto.ca, Kristin Fridgeirsdottir

We consider a web publisher facing uncertain demand from advertisers requesting space through an ad network, and an uncertain supply of clicks from viewers. Formulating the problem as a novel queuing system, we show that the frequently used heuristic applied by most web publishers to convert between the CPC and CPM pricing schemes using the so-called click-through-rate can be misleading and may incur substantial revenue loss for web publishers.

■ TD42

Level 1 -101B

Collaboration and Competition in Supply Chains

Sponsor: Manufacturing & Service Operations Management
Sponsored Session

Chair: Yimin Wang, Arizona State University, W. P. School of Business, Tempe, AZ, 85287, United States of America, Yimin_Wang@asu.edu

1 - Relationship-Specific Investments and Mechanism Design
Sameer Hasija, Insead, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, sameer.hasija@insead.edu, Vladimir Mares

We consider a client's mechanism choice to select one of two vendors with private cost information. The problem is complicated as one vendor with inherent knowledge, potentially generates a higher surplus for the client, subject to the client's relation-specific investment. The trade-off between implementing an optimal skewed mechanism with an ex ante relationship-specific investment and an optimal symmetric mechanism is investigated.

2 - Capacity Pre-selling under the Threat of Bankruptcy
Robert Swinney, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, robert.swinney@duke.edu, Erica Plambeck, S. Alex Yang

We analyze the costs and benefits of preselling capacity by a firm that is prone to bankruptcy. The firm is a price-taker and faces multiple sources of uncertainty, e.g., market price, materials costs, and capacity yield. The firm will enter bankruptcy if its revenue is sufficiently low; to mitigate this, it may presell some capacity at a fixed price. We find the optimal preselling strategy and explore conditions that influence the value of preselling such as customer anticipation of failure.

3 - Countervailing Power, Commitment, and Strategic Quality Improvement
Rui Yin, Assistant Professor, Arizona State University, W. P. Carey School of Business, Tempe, AZ, 85287, United States of America, Rui.Yin@asu.edu, Yimin Wang

A critical factor that influences product quality is supply chain members' joint improvement efforts. In this research we explore two important financial and operational levers that may impact their joint improvement efforts: countervailing power and commitment. We examine the implications of these two levers on the manufacturer and supplier's optimal quality improvement efforts and profits, when their efforts are complements or substitutes.

4 - Are Strategic Customers Bad for a Supply Chain?
Yen-Ting Lin, University of San Diego, School of Business Administration, 5998 Alcala Park, San Diego, CA, 92110, United States of America, linyt@sandiego.edu, Ali Parlakturk, Jayashankar Swaminathan

We examine the impact of having strategic customers on the performance of a two-tier supply chain. We find that customers' strategic behavior can increase firm profitability as well as the total supply chain profit.

5 - Impact of Product Differentiation on Collaborative Sourcing
Muge H. Yayla-Kullu, Assistant Professor, RPI Lally School of Mgmt, 110 8th St., Troy, NY, 12180, United States of America, yaylah@rpi.edu

We discuss how and when supply chain alliances in terms of collaborative sourcing benefit partner firms. We take heterogeneity of the customer base into account. When the products of firms are differentiated, we find that joint consideration of sourcing, pricing, and demand generation objectives may result in outcomes that were not identified in previous literature.

■ TD43

Level 1 -101C

Analytics for Non-profit Organizations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ilya Ryzhov, Assistant Professor, University of Maryland, 4322 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, iryzhov@rhsmith.umd.edu

1 - A Comprehensive Probabilistic Framework for Prediction of Patients' Readmission to Medial Centers
Adel Alaeddini, Assistant Professor, University of Texas at San Antonio, San Antonio, TX, United States of America, Adel.Alaeddini@utsa.edu

The problem of readmission to medical centers after getting discharge often causes serious problems to both patients and medical centers. In this study we develop a comprehensive probabilistic framework based on integration of Survival Models, Bayesian Inference, and Local Regression Analysis to provide an accurate real-time estimate of readmission, personalized for each patient. We also design a comprehensive optimization model to find the optimal parameters of the propose framework.

2 - Improving Fundraising by Trial not Error
Laura Grant, Assistant Professor, University of Wisconsin-Milwaukee, PO Box 413 NWQ B, Room 4450, Department of Economics, Milwaukee, WI, 53201, United States of America, grantle@uwm.edu

Most nonprofit organizations fundraise according to rules of thumb, making changes through intuition. While intuition provides creative ways to solicit donations, the ad hoc process makes it difficult to determine which aspects are most effective. We test numerous fundraisers designed to ask some potential donors in one way and ask others in a slightly different way. The results measure the effectiveness of fundraisers. We give specific examples and ideas for general implementation.

3 - Short-term, Long-term, Social and Spatial Effects of Rewards for Blood Donation: A Field Experiment
Mario Macis, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, United States of America, mmacis@jhu.edu, Robert Slonim, Nicola Lacetera

In a natural field experiment with the American Red Cross we studied the total effects of incentives on pro-social behavior. Subjects offered $5, $10 or $15 gift cards were more likely to donate blood and more so for higher reward values. The rewards also led to social spillovers, spatial displacement and short-term shifts in donation timing, but no long-term effects. Effects were stronger for subjects with lower donation costs and less reputational concerns.

4 - Cultivating Disaster Donors: A Case Application of Scalable Analytics on Massive Data
Ilya Ryzhov, Assistant Professor, University of Maryland, 4322 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, iryzhov@rhsmith.umd.edu, Bin Han, Jelena Bradic

We present an empirical study of the effectiveness of donor cultivation and retention efforts for the American Red Cross, based on 8.6 million communications with past and recurring donors during 2009-2011. We find evidence that regular supporters of the program place surprisingly high value on disaster preparedness. Dynamically generated funding requests, used in 44% of Red Cross appeals, are effective in engaging recent donors, but have an adverse effect on donors whose involvement has lapsed.

■ TD44

Level 1 -101D

Supply and Distribution Risk Management

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Volodymyr Babich, Associate Professor, Georgetown University, Washington, DC, 20057, United States of America, vob2@georgetown.edu

Co-Chair: Zhibin (Ben) Yang, Assistant Professor, University of Oregon, United States of America, zyang@uoregon.edu

1 - Using Weather Insurance to Manage Default Risk for Small Farmers
Candace Yano, Professor, UC Berkeley, IEOR Dept. and Haas School of Bus., Berkeley, CA, 94720, United States of America, yano@ieor.berkeley.edu, Frank (Youhua) Chen

Mitigating risk for small farmers in developing countries is extremely difficult. Crop insurance is available to large farmers, but post-season payouts require a loss assessment, which is too expensive to implement in the case of small farms. We present an approach for combining typical seasonal farm loans with weather insurance and show how to best structure these arrangements to mitigate risk for the lender and farmer.

2 - Subsidizing the Distribution Channel: Donor Funding to Improve the Availability of Malaria Drugs
Wenqiang Xiao, NYU, Stern School of Business, NYC, United States of America, wxiao@stern.nyu.edu, Terry Taylor

We study the question of whether a donor should subsidize the purchases and/or the sales of the private channel. We show that the donor should only subsidize purchases and should not subsidize sales. This result holds when the product life cycle is long, as is typical for malaria drugs. However, this result breaks when the product life cycle is short. Then, it is optimal to offer a sales subsidy if and only if customer heterogeneity and the donor's budget are sufficiently large.

3 - Benefits of Decentralized Decision Making
Elena Belavina, Assistant Professor, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60611, United States of America, Elena.Belavina@chicagobooth.edu, Karan Girotra

The inefficiency of decentralized decision-making is one of the most influential findings of the supply chain coordination literature. This paper shows that with the possibility of continuing trade, decentralization can be beneficial in improving supply chain performance. In a supply chain with decentralized decision-making and continuing trade, it is easier to incentivize players to coordinate on efficient actions.

4 - Should Buyers use Procurement Service Providers if Suppliers Have Private Information on Disruptions

Zhibin (Ben) Yang, Assistant Professor, University of oregon, United States of America, zyang@uoregon.edu, Volodymyr Babich

It is a common practice to hire a PSP, because its knowledge of the supply base improves supplier selection and management. However, economic wisdom is that the buyer is always better off contracting with the suppliers directly, if the PSP's knowledge concerns supply costs. In a model with asymmetric information regarding supply risks, we identify, quantify, and explain all of the benefits and the costs to a buyer of using a PSP, and describe conditions for the benefits to exceed the costs.

■ TD45

Level 1 -101E

Investigations of Tradeoffs in Healthcare Operations: Flexibility, Efficiency, and Clinical Quality

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Anita Tucker, Associate Professor, Harvard Business School, Morgan Hall 413, Soldiers Field, Boston, MA, 02163, United States of America, atucker@hbs.edu

1 - Balancing Responsiveness and Efficiency with Flexibility in the Emergency Department

Lauren Laker, University of Cincinnati, 534 Lindner Hall, Cincinnati, OH, 45220, United States of America, lakerln@mail.uc.edu, Craig Froehle, Christopher Lindsell, Michael Ward

We evaluate the effects on wait time and utilization of flexible partitioning between low & high-acuity areas in an Emergency Department. The results of discrete-event simulation modeling show that introducing flexible rooms, accessible by both low & high-acuity patients, provides substantial operational benefits for ED performance including lower wait times and balanced bed utilization. Furthermore, the optimal policy is shown to be robust to changes in patient mix, volume, and service times.

2 - Service Systems with Adaptive Servers

Mohammad Delasay, PhD candidate, University of Alberta, PhD Program Office, School of Business, University of Alberta, Edmonton, Al, T6G2R6, Canada, delasays@ualberta.ca, Armann Ingolfsson, Bora Kolfal

Healthcare servers do not work at a constant speedóthey may speed up to clear a queue and slow down when fatigued. We develop a quasi-birth-and-death model of a queueing system in which service rates change with the system "load" (fraction of busy servers) and "overwork" (number of users served). We demonstrate that ignoring adaptive server behavior in staffing can result in inconsistencies between planned and realized performance and can lead to unstable, suboptimal, or oscillatory staffing.

3 - Multi-level Preventive Care Design for Type 2 Diabetes

Karca Aral, PhD Candidate, INSEAD, Boulevard de Constance, Fontainebleau, 77300, France, karca.aral@insead.edu, Stephen E. Chick, Alfons Grabosch

We propose a mathematical model for T2 Diabetes that comprehends the interactions of screening policies and preventive interventions. We use the model to design an integrated preventive care policy. We calibrate the model using real data, and compare the model outcomes with clinical recommendations. We conclude by providing insights on multi-level chronic disease prevention.

4 - The Impact of Conformance and Experiential Quality on Healthcare Cost and Clinical Performance

Claire Senot, The Ohio State University, 2100 Neil Ave., Columbus, OH, United States of America, senot_1@fisher.osu.edu, Aravind Chandrasekaran, Peter T. Ward, Anita Tucker

We investigate the relationship between a dual focus on conformance and experiential quality in the process of care and hospitals' cost and clinical performance. We collect data for 3458 U.S. acute care hospitals over 3 years. Findings reveal a trade-off between clinical outcomes and cost efficiency.

■ TD46

Level 1 -101F

Sustainability and Environmental Operations

Contributed Session

Gokhan Egilmez, Assistant Professor, North Dakota State University, North Dakota State University, Fargo ND, United States of America, gokhan.egilmez@ndsu.edu

1 - The Effects of Air Quality on Multi-year Electricity Production Planning

Paul Kerl, Georgia Institute of Technology, 500 Tech Parkway, Atlanta, GA, 30332, United States of America, paul.kerl@gatech.edu, Valerie Thomas

Production of electricity from fossil fuels releases pollutants that have negative health effects such as premature mortality. We create a mathematical formulation of a multi-decade least-cost electricity capacity planning model that newly integrates simulated emission-pollutant sensitivities from a chemical transport model (CTM) to model air pollutant concentrations and related health effects. We then examine planning for the state of Georgia within this electricity capacity planning framework.

2 - GreenRoute Platform

Georgios K.D Saharidis, University of Thessaly, Leoforos Athinon, Pedion Areos, Volos, Greece, saharidis@gmail.com, George Liberopoulos, George Kolomvos

We propose an online web-based platform which provides optimal solutions to the environmental vehicle routing problem. The platform use static and dynamic, qualitative and quantitative data to estimate the environmental externalities of a route. The environmental externalities are defined through the Environmental Externality Score function (EES) which is related to transportation network factors influencing the fuel consumption such as traffic, infrastructure profile, and weather conditions.

3 - Sustainability Performance Assessment of U.S. Food Manufacturing: A Fuzzy Eco-efficiency Analysis

Gokhan Egilmez, Assistant Professor, North Dakota State University, North Dakota State University, Fargo, ND, United States of America, gokhan.egilmez@ndsu.edu, Serkan Gumus, Murat Kucukvar

Current study assessed the direct and indirect environmental footprint of 33 U.S. food manufacturing sectors by using the Economic Input-Output Life Cycle Assessment (EIO-LCA) model. Then, Fuzzy Data Envelopment Analysis (Fuzzy-DEA), is utilized to benchmark the sustainability performance of the sectors by using the results of the EIO-LCA model. Later, fuzzy eco-efficiency values are provided along with projected improvements and sensitivity analysis of selected sustainability indicators.

■ TD47

Level 1 -101G

Queuing Games and Pricing

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Laurens Debo, Associate Professor, University of Chicago, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu

1 - Abandonment and Pricing in Queueing Systems

Philipp Afeche, University of Toronto, 105 St. George Street, Toronto, ON, M5S 3E6, Canada, philipp.afeche@rotman.utoronto.ca, Vahid Sarhangian

Order cancellations can be observed in practice, but the literature on congestion pricing appears to ignore the possibility of customer abandonment. We study a queueing model in which customers may abandon the system and explore pricing implications.

2 - Customer Learning and Abandonment in Congested Systems

John Yao, Columbia University, New York, NY, United States of America, jyao14@gsb.columbia.edu, Assaf Zeevi, Costis Maglaras

In deciding whether or not to join a queue, strategic customers need some estimate of their delay costs. Even when queues are observable, the processing capacity of the system is rarely known to the customer. We describe a model in which strategic customers waiting in an observable queue assess whether they should stay or abandon the system by forming real-time departure rate estimates based on their progress in the queue.

3 - Blind Queues: The Impact of Consumer Beliefs on Revenues and Congestion

Shiliang Cui, Doctoral Student, The Wharton School, University of Pennsylvania, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, scui@wharton.upenn.edu, Senthil Veeraraghavan

In many service settings, consumers have to join a queue without being fully aware of service parameters. In such "blind" queues, consumers make their decisions based on limited information. We consider a firm serving consumers with arbitrarily misinformed beliefs about the firm's service information, and explore how firm revenues and consumer welfare are impacted if the firm were to reveal its service parameters.

4 - Signaling by Price in a Congested Environment

Laurens Debo, Associate Professor, University of Chicago, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu, Uday Rajan, Senthil Veeraraghavan

We consider the informational role of a queue when a firm can also adjust its price to signal its quality to uninformed consumers. We exhibit equilibria in which the queue almost perfectly reveals the quality. Here, short queues are associated with the low-quality firm and long queues with the high-quality one. Queues can be more efficient signaling instruments than prices.

■ TD48

Level 1 -101H

Behavioral Issues in Forecasting and Inventory Management

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Elena Katok, Ashbel Smith Professor, University of Texas at Dallas, Jindal School of Management, 800 W. Campbell Dr., Richardson, TX, 75080, United States of America, ekatok@utdallas.edu

1 - Integrating Judgmental Forecasts: The Role of Functions, Incentives and Social Value Orientation

Stefanie Protzner, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, sprotzner@rsm.nl, Clint Pennings, Laurens Rook, Jan van Dalen

Lack of integration of sales and operations is an important shortcoming of judgmental forecasts, potentially undermining their accuracy. We posit that differential roles, incentives and social value orientation impact demand forecasts, and examine an integrative mechanism to pool information under such circumstances. Results confirmed that judgmental forecasts can indeed become more accurate once we account for forecasters' social value orientation and changes in role and incentive structure.

2 - Judgmental Forecasting and Biases in a Company

Clint Pennings, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, T Building, Room 9-30, Rotterdam, 3062 PA, Netherlands, cpennings@rsm.nl, Jan van Dalen, Laurens Rook, Stefanie Protzner

Judgmental forecasting is central to the forecasting process at many companies, but is subject to many biases. An experiment was conducted in which respondents forecast demand and provide input to a planning meeting. Psychological traits are examined to analyze unintentional biases; different departmental roles and incentives (asymmetrical cost functions) are used to influence intentional biases. Various dynamic models are constructed and compared to assess the behavior of respondents.

3 - Framing and Anchoring Effects in Forecast Sharing

Jud Kenney, Doctoral Candidate, McGill University, 1001 rue Sherbrooke Ouest, Montreal, QC, H3A 1G5, Canada, jud.kenney@mail.mcgill.ca, Saibal Ray, Jim Engle-Warnick

This study builds on recent research regarding behavioral issues in the context of forecast sharing (e.g., ÷zer, Zheng, & Chen, 2011). Our behavioral experiment establishes and measures the impact of framing and anchoring effects in forecast sharing. Specifically, our framing treatment attempts to compare and contrast behavior between the retail sector where demand uncertainty plays a major role and sectors such as defense and aerospace, where supply uncertainty dominates demand uncertainty.

4 - Days of Supply vs. Inventory Turns: A Behavioral Perspective

Ulrich Thoneman, University of Colgone, Germany, Ulrich.Thonemann@uni-koeln.de, Tobias Stangl

The two most common inventory performance metrics are "days of supply" and "inventory turns". Although, from normative perspective, both metrics measure the same (with one being the inverse of the other), they can differ substantially when used by human decision makers: We show that days of supply is leading to better resource allocation decisions while inventory turns motivates subjects to exert more effort.

■ TD49

Level 1 -101I

Stochastic Variational Inequality Problems: Applications, Analysis, and Algorithms

Cluster: Tutorials

Invited Session

Chair: Uday Shanbhag, University of Illinois at Urbana-Champaign, Urbana, IL, 61801, United States of America

1 - Stochastic Variational Inequality Problems: Applications, Analysis, and Algorithms

Uday Shanbhag, Pennsylvania State University, 353 Leonhard Building, University Park, PA, 16802, United States of America, udaybag@engr.psu.edu

We consider the stochastic variational inequality problem, where the components of the associated map may contain expectations. The focus of the tutorial is two-fold: (i) Analysis: Integration—free sufficiency conditions for existence are provided by combining Lebesgue convergence theorems with standard variational analysis; and (ii) Computation: A range of stochastic approximation schemes are described for computing the associated solutions.

■ TD50

Level 1 -101J

Energy VI: Power Generation with Demand Consideration

Contributed Session

Chair: Mona Asudegi, PhD Candidate, University of Maryland, 9348 Cherryhill Rd. Apt. 811, College Park, MD, 20740, United States of America, asudegi@umd.edu

1 - A Time Indexed ARX based Hourly Cooling Load Prediction Scheme via Two-Stage Weighted Least Squares

Yin Guo, Energy Conservation Research Engineer, University of Nebraska-Lincoln, W151 NH, Lincoln, NE, 68588, United States of America, yguo4@unl.edu, Ehsan Nazarian, Jeonghan Ko, Kamlakar Rajurkar, Haseung Chung

An accurate cooling load prediction is essential for optimal control of HVAC systems. This paper introduces an hourly cooling load prediction scheme based on time indexed autoregressive with exogenous inputs (ARX) models. The prediction scheme uses two separate ARX models for different periods of forecast time. A two-stage weighted least squares regression approach is introduced for fast and adaptive coefficient estimation in addition to detecting outliers.

2 - Load-shed Detection in Demand Response Programs

Carlos Abad, Columbia University, S.W. Mudd Building 321, 500 W 120th St., New York, NY, 10027, United States of America, ca2446@columbia.edu, Garud Iyengar

We compare four signal processing algorithms for detecting load-sheds in Dr. programs. Three of these methods (edge detection, dictionary-based and bayesian inference) exploit the sparseness and structure of the load-shed. These algorithms outperform the LASSO benchmark, and are able to recover load-sheds to within 10% error. We implement an online version of the bayesian method that is competitive with its offline version. We discuss further applications in which these methods may be useful.

3 - A Real Time Algorithm for Demand Management in Smart Grid

Mona Asudegi, Ph.D Candidate, University of Maryland, 9348 Cherryhill Rd. Apt. 811, College Park, MD, 20740, United States of America, asudegi@umd.edu, Ali Haghani

Developing an advanced system which can accommodate green energy and technologies such as solar, wind energy, and electrical vehicles in the electric power grid and also applying an appropriate demand management system are fundamental keys toward resolving some of the energy concerns in the world. This study is focused on developing a dynamic demand response model and also an efficient algorithm for solving the model for the advanced electric grid system, Smart Grid.

■ TD51

Level 1 -102D

New Traffic Signal Control Schemes

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Qing He, SUNY Buffalo, 313 Bell Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu

1 - Performance Measures of Manual Multi-modal Traffic Signal Control

Qing He, SUNY Buffalo, 313 Bell Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu, Nan Ding, Sean Wu

Traffic control agencies (TCA), including police officers, firefighters or other traffic law enforcement officers, who override automatic traffic signal control, are crucial to mitigate non-recurrent traffic congestions, caused by planned and unplanned events. This work assesses the performance of TCA-based manual multi-modal traffic signal control under special events.

2 - Integrated Optimization of Lane Markings and Timings for Signalized Roundabouts

Yue Liu, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee, Milwaukee, WI, United States of America, liu28@uwm.edu

This paper contributes to developing an integrated optimization model that is able to simultaneously determine lane markings and timings for a signalized roundabout. A precedence graph is uniquely designed to formulate a unified phase structure at both approaches and circulatory lanes. Capacity maximization, cycle length minimization, and delay minimization problems are formulated to optimize the operation of a roundabout.

3 - Operation of Signalized Diamond Interchanges with Frontage Roads using Dynamic Reversible Lane Control Signs

Yue Liu, Department of Civil Engineering and Mechanics, University of Wisconsin-Milwaukee, Milwaukee, WI, United States of America, liu28@uwm.edu, Jing Zhao

This paper presents an innovative design and operational model for signalized diamond interchange by dynamically reversing certain lanes in the internal link on a regular basis with the deployment of overhead reversible lane control signs. A Binary-Mixed-Integer-Linear-Program (BMILP) is formulated to simultaneously optimize lane markings, dynamic usage of the reversible lane, and signal timings for the new system.

■ TD52

Level 1 -102E

Freight Logistics II

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Xiaopeng Li, Mississippi State University, Department of Civil and Environmental En, PO Box 9546, 235L Walker Hall, 501 Hardy, Mississippi State, MS, 39759, United States of America, xli@cee.msstate.edu

1 - Urban Freight Performance Measurement using GPS Data

Xia Yang, Urban Freight Performance Measurement Using GPS Data, RPI, TROY, NY, 12180, United States of America, yangx5@rpi.edu, Jose Holguin-Veras, Xuegang Ban, Jeff Wojtowicz

We present methods for using GPS data to measure urban freight performances. Case studies will be conducted using data from major metropoltian areas.

2 - Tactical Supply Chain Planning under Supplier Uncertainty

Aly Megahed, Ph.D. Student, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, aly@gatech.edu, Marc Goetschalckx

We present a comprehensive tactical supply chain planning model for multi-echelon, multi-period, and multi-commodity supply chains that incorporates supplier uncertainty in its most general form. It is modeled as a two-stage stochastic programming model. We show both theoretical and numerical results for the effect of supplier uncertainty on procurement decisions. We also apply our model to a real-world wind turbines supply chain

3 - Green Logistics in the Batch Process Industry: An Integrated Model

Nagham El-Berishy, PhD Student, Universität Bremen, Intl. Grad. School for Dynamic Logistic, c/o BIBA, room no. 0540, Bremen, 28359, Germany, elb@biba.uni-bremen.de, Bernd Scholz-Reiter

Green logistics within the batch process industry is a promising up-to-date theme that enables sustainability and efficiency in supply chains. Optimizing production and transportation processes by considering green aspects are the main objectives of our research. This paper formulates a mathematical model which is capable to present the related issues in batch industry. Model results show that the total related cost can be minimized. These results have been verified for several problem sizes.

4 - Robust Optimization of Relay Networks for Truckload Transportation

Hector A. Vergara, Assistant Professor, Oregon State University, 204 Rogers Hall, Corvallis, OR, 97331, United States of America, hector.vergara@oregonstate.edu, Zahra Mokhtari

Relay networks (RNs) have been proposed as an alternative approach to dispatch loads in truckload trucking. They provide several benefits over traditional direct dispatching such as shorter tours for drivers. We study the strategic design of RNs considering operational limitations. We present a comprehensive review of different model formulations and solution methods for this problem and suggest a robust optimization approach to capture major sources of uncertainty that exist in practice.

5 - Dynamic Crossdocking Optimization

Monique Guignard, Professor, University of Pennsylvania, Wharton School, OPIM Department, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, guignard_monique@yahoo.fr, Peter Hahn, Heng Zhang

Crossdocks in a supply chain aim at reducing transportation and inventory costs. Freight from incoming trailers must be sorted and loaded into outbound trailers. We concentrate on assigning trucks to doors to avoid congestion on the floor and improving the use/cost of the workforce. Our prototype system assigns trailers dynamically through a workday, updating the loading/unloading operations and solving quadratic door assignment models. It has been tested on realistic data from one company.

■ TD53

Level 1 -102F

Vehicle Routing Applications

Contributed Session

Chair: Luke Holt, Ph.D. Candidate, North Dakota State University, 7084 148th Ave. NE, Grafton, ND, 58237, United States of America, luke.holt@ndsu.edu

1 - Overland Move Planning for Intermodal Logistics using Column Generation Technique

Z. Melis Teksan, PhD Student, University of Florida, Industrial and Systems Engineering, 303 Weil Hall, Gainesville, Fl, 32611-6595, United States of America, zmteksan@ufl.edu, Tianyi Pan, Joseph Geunes, Joseph Hartman

This study is motivated by a practical logistics planning problem faced by a maritime logistics firm seeking to optimize overland operations. The objective is to minimize the number of empty miles, while meeting the movement requirements for all orders. The problem is a variant of the full truckload vehicle routing problem with time windows, which is NP-hard. We provide a full mixed integer linear programming formulation and a column generation scheme to obtain near optimal solutions.

2 - A Constraint Programming Approach to Designing a Newspaper Distribution System

Robert Russell, Profesor, Univ of Tulsa, 800 S Tucker Drive, College of Business, Tulsa, OK, 74104, United States of America, rrussell@utulsa.edu

A constraint programming approach is developed using a modeling language and CP Optimizer to aid in the coordination of the production and delivery of multi-product newspapers to bulk delivery locations. The distribution problem is modeled as an open vehicle routing problem with time windows and zoning constraints. Computational results are presented and show significant improvement relative to a previous metaheuristic approach using tabu search.

3 - A Static Regional Routing Model for Large Geographic Healthcare Networks

Luke Holt, Ph.D. Candidate, North Dakota State University, 7084 148th Ave. NE, Grafton, ND, 58237, United States of America, luke.holt@ndsu.edu, Joseph Szmerekovsky, Sumadhur Shakya

We study a two echelon healthcare distribution network with sequence restrictions and delivery deadlines. It involves a large geographic network spread across six states visiting hospitals, clinics, and long-term care facilities. Due to the fast pace growth of the network, supply chain planners are forced to determine routes that provide appropriate service. We present a vehicle routing model that minimizes the system costs associated with vehicle trips when scheduling vehicle routes.

4 - Integrating Operations Research and GIS: Paradigms and Implications for Value Addition

Avijit Sarkar, Associate Professor, University of Redlands, 1200 E. Colton Avenue, Redlands, CA, 92373, United States of America, avijit_sarkar@redlands.edu, Hindupur Ramakrishna

Geographic information systems (GIS) are increasingly being combined with operations research (OR) to solve complex, large scale problems in many sectors. We systematically investigate OR literature and provide taxonomy of articles in this area. Paradigms of integration of OR and GIS are examined by analyzing the extent and nature of contributions made by a GIS. Implications of various integration paradigms are discussed to understand the value created by integration of GIS with OR.

■ TD54

Level 1 -103A

Innovative Modeling and Data Sources for Intersections

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Yang Cheng, PhD, University of Wisconsin-Madison, 1241 Engineering Hall, Madison, WI, 53706, United States of America, cheng8@wisc.edu

1 - Utilizing Multiple Wireless Roadside Sensors At Intersections

David Kim, Oregon State University, Corvallis, OR, United States of America, david.kim@orst.edu, SeJoon Park, David Porte, Nadia Bathaee, Alireza Mohseni

This research examines the estimation of vehicle time-distance trajectory through an intersection utilizing the data collection capabilities of multiple wireless roadside sensors that have been deployed along an intersection. Prior research with Bluetooth wireless roadside sensors show that signal strength data collected when data is obtained from a wireless device present in a vehicle can be used to estimate when the vehicle is close to passing a sensor. This capability is exploited through the development of portable Bluetooth wireless data collection units that communicate and synchronize time utilizing a Zigbee mesh network.

2 - Trajectory-based Vehicle Fuel Consumption/Emissions Estimation using Mobile Sensing Data

Zhanbo Sun, Rensselaer Polytechnic Institute, 12 25th St., Troy, NY, 12180, United States of America, sunz2@rpi.edu, Xuegang Ban

In this research, trajectory-based energy/emissions estimation method is proposed for signalized arterials. Using mobile sensing data, the method constructs the trajectories of the entire traffic population. Macro-scale and micro-scale energy/emission estimations are provided. The results show that adding random noise to the cruise mode and using state-dependent acceleration process lead to better estimations. It is found that the estimations are typically within 15% of the ground truth values.

3 - A Novel Cooperative Reinforcement Learning Algorithm for Signal Control Coordination

Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, H. M. Abdul Aziz, Feng Zhu, Xinwu Qian

This study develops a novel cooperative Reinforcement Learning algorithm for coordinated signal control problem. Traffic signals are modeled as reinforcement learning agents with communication capabilities. A novel algorithm derived from Junction Tree Algorithm is proposed to obtain the best joint actions in the updating procedure of Q-values in the framework of cooperative reinforcement learning. Moreover, with minor changes, the algorithm is well suited to address the green wave traffic control problem. The algorithm is implemented and tested at a 3◊6 grid network by utilizing a traffic simulator (VISSIM).

4 - A Hybrid Model of Trip Information Extraction from Personal Trajectory Data

Yang Cheng, PhD, University of Wisconsin-Madison, 1241 Engineering Hall, Madison, WI, 53706, United States of America, cheng8@wisc.edu

The GPS-abled personal digital devices, such as smart phones and tablet, can be used for automatic travel survey data collection. However, in metropolitan areas, travelers' daily trips usually use a variety of modes. Some of the modes are hard to distinguish. A hybrid method integrating the neural network and trajectory critical points is proposed to extract trip information from travelers' trajectory data. The neural network is used for first level classification; the trajectory critical points, defined as the data points representing transfers between different travel states, are extracted and used for the second level classification. The proposed method was by real personal trajectory data. The results indicate that the proposed method did well in both accuracy and consistency.

■ TD55

Level 1 -103B

Scheduling I

Contributed Session

Chair: Victoria Ellison, NCSU Operations Research Department, Campus Box 7913, 2500 Stinson Dr., Raleigh, NC, 27695, United States of America, vmellison@ncsu.edu

1 - Scheduling with Variable Machining Costs

Guohua Wan, Professor, Shanghai Jiao Tong University, 535 Fahuazhen Road, Shanghai, 200052, China, ghwan@sjtu.edu.cn

We study scheduling problems on parallel machines with variable machining costs and regular performance measures, where machining cost is the cost when using the machines to process jobs and it is time-variant. Several models with job release times and preemptions are considered and DP-based algorithms are developed. Applications of the models to electric vehicle power charging are presented as well.

2 - Campbell Dudek Smith Flowshop Algorithm Content of Combinatorial Algorithm Conditions

Milton Smith, Professor, Texas Tech University, Industrial Engineering, Main Stop 3061, Lubbock, TX, 79409, United States of America, milton.smith@ttu.edu

The Campbell Dudek Smith (CDS) algorithm is known for its simplicity and its performance in minimizing flowshop makespan. The Smith Dudek (SD) optimizing algorithm developed simultaneously with CDS has a number of conditions that when met let one job dominate other jobs for the next sequence position. Analysis of the SD conditions reveals that CDS contains a portion of the SD conditions and provides the reason for CDS effectiveness.

3 - Worst-case Performance Analysis of Certain Approximation Algorithms

Peruvemba S. Ravi, Operations and Decision Sciences, School of Business & Economics, Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, N2L3C5, Canada, pravi@wlu.ca, Levent Tuncel, Michael Huang

The mean flow time for a set of jobs on a set of parallel identical machines can be readily minimized by using the SPT rule. We address the problem of selecting the schedule with the smallest makespan among the class of all such flowtime-optimal schedules. We propose new techniques for determining bounds on the performance of approximation algorithms for this problem.

4 - Scheduling with Past-sequence-Dependent Setup Times and Learning Effects on a Single Machine

Hossein Soroush, Professor, Kuwait University, Dept. of Stat. & OR, P. O. Box 5969, Safat, 13060, Kuwait, h.soroush@ku.edu.kw

We study a single machine scheduling problem with job-dependent past-sequence-dependent setup times and job-dependent position-based learning effects. The goal is to find the schedule that minimizes each of the performance criteria the sum of the rho-th powers of completion times, the maximum tardiness, the total tardiness, the total weighted completion time, and the total absolute differences in waiting times.

5 - A Cutting Plane Method for a Multi-Objective Group Assignment Problem

Victoria Ellison, NCSU Operations Research Department, Campus Box 7913, 2500 Stinson Dr., Raleigh, NC, 27695, United States of America, vmellison@ncsu.edu, Amy Langville, Tim Chartier

A BILP is formulated for a multi-objective group assignment problem and is then related to the stable matching problem. We prove the partial total unimodularity of the BILP and use the Gale-Shapely algorithm to develop a cutting plane algorithm for all BILPs of the same structure. Our work is applied to a group project assignment problem which maximizes the number of workers assigned to a project, the workers preference for their assigned project, and the diversity of the workers in each group.

■ TD56

Level 1 -103C

Integrating Renewables and Security Constraints

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Golbon Zakeri, Dr., University of Auckland, 70 Symonds street, Auckland, New Zealand, g.zakeri@auckland.ac.nz

1 - Transmission Expansion Planning as a Dynamic MILP that Considers the Long Term Availability of Wind

Enzo Sauma, Associate Professor, Pontificia Universidad Catòlica de Chile, Ave. Vicuna Mackenna 4860, Santiago, RM, Chile, esauma@ing.puc.cl, Javier Contreras, Jose Aguado, Sebastian De la Torre

There are still several challenges to be faced in the transmission planning problem. In particular, considering large market penetration of wind energy, there are challenges associated, for instance, to the analysis of the uncertainty associated to the long-term availability of the wind resource. We formulate the transmission expansion planning problem as a dynamic (multi-period) Mixed-Integer Linear Programming (MILP) problem, in which we model the long term availability of wind energy.

2 - Modeling Alternative Energies

Miguel Perez de Arce, Pontificia Universidad Catòlica de Chile, Cerro Lagunillas Oriente 6425. Peñalolen, Santiago, Chile, mfperezj@uc.cl, Enzo Sauma

Energies such as geothermal, wind, among others, have been adopted by different countries as alternative energy to traditional sources, for which purpose different mechanisms are applied to its incorporation into the matrix of energy. In this paper we analyze some of the mechanisms with respect to their influence on the degree of penetration of alternative energy sources.

3 - Probabilistic n-K Security Criterion with Significant Renewable Energy Resources Generation

David Pozo, Pontificia Universidad Catòlica de Chile, Avenue Vicuña Mackenna # 4860, Santiago, Chile, davidpozocamara@gmail.com, Javier Contreras

We present a new approach for the joint energy and reserves scheduling and unit commitment with n-K reliability constraints for the day-ahead market. The proposed method includes an n-K criterion where demand must be met with a specified probability under any simultaneous loss of K generating units. A chance-constrained method is proposed to determine the confidence level to meet the demand under K simultaneous contingencies. The effect of increasing renewable penetration is analyzed.

4 - Mechanism Design to Harness Volatile Renewables

Golbon Zakeri, Dr., University of Auckland, 70 Symonds street, Auckland, New Zealand, g.zakeri@auckland.ac.nz, Javad Khazaei, Shmuel Oren

We will describe 3 different market clearing mechanisms, one in current practice, one proposed to enhanced the utilization of renewables and a third variant. We will demonstrate the quivalence of these mechanisms under particular conditions, describe the resulting market equilibria and compare these mechanisms in terms of social welfare.

■ TD57

Level 1 -103D

Generation Investment: Hierarchical Models and Equilibria

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Antonio Conejo, University of Castilla-La Mancha, Department of Electrical Engineering, Campus Universitario, Ciudad Real, 13071, Spain, Antonio.Conejo@uclm.es

1 - Wind Power Investment: A Risk-constrained Multi-stage MPEC Approach

Luis Baringo, University Castilla - La Mancha, E.T.S.I. Industriales, Ciudad Real, 13071, Spain, Luis.Baringo@uclm.es, Antonio Conejo

The investment in wind facilities is highly conditioned by the uncertainty in demand and wind production, the eventual decline of investment cost, and the risk of profit volatility associated to the investment decisions. Considering these important issues, this presentation provides a stochastic risk-constrained multi-stage MPEC to decide the optimal investment on wind facilities of an investor that aims at maximizing its expected profit while minimizing its risk of profit volatility.

2 - Generation Investment Equilibria with Strategic Producers in an Electricity Pool: An EPEC Approach

S. Jalal Kazempour, PhD Student, University of Castilla - La Mancha, E.T.S. Ingenieros Industriales, Ciudad Real, 13071, Spain, jalal.kazempour@gmail.com, Antonio Conejo, Carlos Ruiz

We study generation investment equilibria with strategic producers in a network-constrained pool. The investment problem of each producer is modeled through a bilevel model, which is transformed into an MPEC using a primal-dual transformation. The joint consideration of all producer MPECs constitutes an EPEC. To identify its solutions, each MPEC is replaced by its KKT conditions, which are in turn linearized. The equilibria represented by such conditions are explored using an auxiliary MILP.

3 - Transmission and Wind Investment in a Deregulated Electricity Industry

Lajos Maurovich-Horvat, PhD Student, University College London, Gower Street, London, WC1E 6BT, United Kingdom, l.horvat@ucl.ac.uk, Trine K. Boomsma, Afzal S. Siddiqui

We present stochastic bilevel programming models to analyse the interaction between transmission expansion and generation investment decisions in a network with uncertain wind profile. In the upper level, the merchant investor decides where to build transmission capacity constrained by the lower-level optimisation problems of producers and transmission capacity allocation. We examine the effect of various grid investment objectives and conjectural variations for the producers' price response.

4 - Approximation of Bilevel Generation Capacity Investment Equilibria

Sonja Wogrin, IIT, Comillas Pontifical University, Madrid, Spain, sonja.wogrin@iit.upcomillas.es, Efraim Centeno

We propose a new methodology to approximate bilevel generation capacity equilibria using only single-level capacity equilibrium models and apply this approximation scheme to generation expansion planning in liberalized electricity markets. With the proposed approximation scheme, we are able to solve the bilevel model reasonably well by smartly employing single-level models which reduces the computational time by two orders of magnitude.

■ TD58

Level 1 -103E

Modeling in Energy Markets and Systems

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Lindsay Anderson, Assistant Professor, Cornell University, 320 Riley Robb Hall, Ithaca, NY, 14853-5701, landerson@cornell.edu

Co-Chair: Matt Davison, Professor, University of Western Ontario, London, ON, Canada, mdavison@uwo.ca

1 - On Scheduling and Deadline Differentiated Pricing of Deferrable Demand

Eilyan Bitar, Cornell University, Ithaca, NY, United States of America, eyb5@cornell.edu, Yunjian Xu

A large fraction of total electric load is inherently deferrable in time. In the following, we propose a novel market, where consumers consent to deferred electric power service in exchange for a reduced price of energy. The longer the willingness to defer, the larger the reduction in price. We jointly characterize scheduling policies and differentiated prices that are both efficient and incentive compatible, in that every consumer would like to reveal her true deadline to the supplier.

2 - Risk-averse Optimal Stochastic Battery Storage Operation in the Presence of Price Impacts

Somayeh Moazeni, Princeton University, Princeton, NJ, United States of America, somayeh@Princeton.EDU, Warren Powell

Formulation and solution of an optimal stochastic storage operation with non-stationary stochastic electricity prices and loads, a stochastic energy source, and transaction costs of trading electricity with grid are discussed. Transaction costs explain price impacts that the storage operation creates on the electricity spot price. An optimal transmission policy for a finite planning horizon, among energy source, grid and the storage to minimize risk is developed and analyzed using ADP methods.

3 - Two-stage Stochastic Optimization for Energy Planning in Microgrids

Gabriela Martinez, Institute for Mathematics and its Applications, 207 Church Street SE, 306 Lind Hall, Minneapolis, MN, United States of America, mgmartin@ima.umn.edu, Nikolaos Gatsis, Georgios B. Giannakis

Microgrids are small footprint power systems featuring distributed generation from conventional and renewable energy sources, distributed storage, and controllable loads. This work tackles energy planning in microgrids where energy can be transacted with the main grid. First-stage decisions include conventional generation, storage, and controllable load schedules, while energy transaction and load adjustments take place at the second-stage to maintain the supply-demand balance.

4 - Analysis of the Combined Use of Pumped Hydro Storage with a Kenyan Wind Farm: Stochastic DP Approach

C. Lindsay Anderson, Assistant Professor, Cornell University, 320 Riley Robb Hall, Ithaca, United States of America, cla28@cornell.edu, Maureen Murage

The Lake Turkana Wind Power (LTWP) project, the largest wind farm in East Africa is to be completed in 2016 and will contribute to 16% of the total generation installed capacity in Kenya. In this study we investigate the benefits of operating the LTWP in conjunction with pumped hydro storage. This includes the development of a stochastic dynamic programming model. This model seeks the optimal control strategy of wind energy combined with storage by maximizing the wind farm's expected revenue.

■ TD59

Level 1 -103F

Climate Change and Policy

Contributed Session

Chair: Felipe Feijoo, University of South Florida, 4202 E. Fowler Ave., ENB118, Tampa, FL, United States of America, felipefeijoo@mail.usf.edu

1 - Modeling Carbon Control Policies: Tax versus Cap-and-Trade

Arvind Sainathan, Nanyang Business School, Nanyang Technological University, 50 Nanyang Avenue, Singapore, Singapore, asainathan@ntu.edu.sg, S. Viswanathan, Jing Wang

We consider and compare the performance of two key carbon control policies: carbon tax and cap-and-trade. We characterize the Stackelberg equilibrium under the tax policy, and the unique trading equilibrium in the cap-and-trade policy. We also consider other well-known mechanisms for carbon control, and compare them with these two policies. Finally, we propose alternative mechanisms for carbon control, and derive key insights based on our analysis.

2 - Developing an Adaptive Stochastic Integrated Assessment Model of Climate Change

Soheil Shayegh, PhD candidate, Georgia Tech, 1056 Longley Avenue NW, Atlanta, Ga, 30318, United States of America, soheilsh@gatech.edu, Valerie Thomas

We will analyze a dynamic integrated model of climate and economy under uncertainty from the climate sensitivity parameter. We will introduce a novel and simple approximate dynamic programming algorithm to solve the finite horizon stochastic problem. We model the tipping point events and show that in wake of uncertain tipping point events harsher policies are optimal for early stages of decision making.

3 - Pricing Model for a Carbon Capture and Storage Contract

Wenbo Cai, Assistant Professor, New Jersey Institute of Technology, 323 Martin Luther KIng Jr.Blvd, Newark, NJ, 07302, United States of America, cai@njit.edu, Dashi Singham, Josh White, Emily Craparo

Efforts are currently underway to deploy carbon capture and storage (CCS) at a commercial scale. Faced with a tax on carbon dioxide emissions, power plant operators may capture carbon dioxide and contract with a sequestration operator to inject it underground. We analyze the problem of optimizing a pricing model for a CCS network while maximizing the total carbon captured. The operator chooses an optimal contract to offer the power plant in the face of uncertainty in the capture costs.

■ TD60

Mezzanine - 100A

Kernel Methods in Data Analytics

Sponsor: Data Mining

Sponsored Session

Chair: Theodore B. Trafalis, Professor, University of Oklahoma/School of ISE, 202 West Boyd, Rm 124, Norman, OK, 73019, United States of America, ttrafalis@ou.edu

1 - Facility Allocation by using Weighted Support Vector Machines

Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu, Samir Alwazzi, Theodore B. Trafalis

In this work we employ the Weighted Support Vector Machine (WSVM) approach to solve a facility allocation problem (FAP). The WSVM approach used in this work is a new solution technique that was not applied to allocate facilities previously; preliminary results are presented.

2 - Imbalanced Support Vector Machine Classification with Label Noise

Petros Xanthopoulos, University of Central Florida, Orlando, FL, United States of America, petrosx@ucf.edu, Onur Seref, Tallayeh Razzaghi

In this paper we are dealing with the problem of imbalanced classification in the presence of label noise. Typically the most approaches for imbalanced classification demonstrate poor performance in environment with noise. We proposed a Weighted Relaxed Support Vector Machine (WRSVM) approach that combines the principles of cost sensitive learning and constraint relaxation for dealing with this problem.

3 - Time Series Analysis for Detecting Suspicious Accounting Activities in Software Companies

Zhen Zhang, University of Oklahoma, Norman, OK, United States of America, zhenzhang0217@gmail.com, Theodore B. Trafalis

This paper offers a novel methodology using several new ratios and comparison approaches to evaluate public software companies' financial condition. Kernel methods are used for incorporating text information. The methodology focuses on time series data monitoring, comparison and revision. Preliminary computational results are presented.

■ TD61

Mezzanine - 100B

Transportation Constraints in Biofuel Supply Chain Infrastructure Systems

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Yongxi Huang, Clemson University, 314 Lowry Hall, Clemson, SC, 29634, United States of America, yxhuang@clemson.edu

1 - Estimating the Cost of a Biomass Feedstock Supply Chain using GIS Data

T. Edward Yu, Asssistant Professor, University of Tennessee, Dept of Agri. & Resource Economics, Knoxville, TN, 37996-4518, United States of America, tyu1@utk.edu, Zidong Wang, Burton English, James Larson

The cost of biomass feedstock supply is crucial to the development of a cellulosic biofuel industry. This study applies a geo-spatial optimization model to estimate the cost of biomass feedstock at the gate of a biorefinery in Tennessee. Considering the road network and various GIS data, the preliminary results suggest that location conditions, such as the degree of feedstock draw area dispersion and the topography of draw area around the biorefinery, have important impacts on feedstock cost.

2 - A Hub-and-Spoke Supply Chain Design for Biomass Co-Fire in Power Plants

Sandra Eksioglu, Associate Professor, Mississippi State University, PO Box 9542 206 McCain Engineering Bld., MSState, MS, 39762, United States of America, sde47@ise.msstate.edu, Md Roni, Erin Searcy

We propose a hub-and-spoke supply chain design for biomass cofire in power plants. This design relies on high-volume, long-haul transportation of densified biomass to power plants by railways. We develop a bender's decomposition heuristic to solve the problem. The goal of the numerical experiments is to show if there is a benefit of using high-volume, long-haul transportation to increase biomass supply, or relying on local resources. We use the billion ton study data to validate our results.

3 - Optimal Design and Operational Planning for Co-Located Ethanol Plant

Guiping Hu, Iowa State University, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu, Longwen Ou, Robert Brown

The commercialization of cellulosic ethanol is hindered by high capital and production cost. In this study, a mathematical model is formulated to optimize the design and operation of a flexible co-located first and second generation ethanol plant. The plant design and operational decisions are studied. The optimal product portfolios and equipment capacity planning under a variety market conditions are analyzed. The net present values of the flexible plant and a convention plant are compared.

4 - Design of Multimodal Transportation System for Cellulosic Biofuel Supply Chain

Fei Xie, Graduate Research Assistant, Clemson University, 131K Lowry Hall, Clemson University, Clemson, SC, 29634, United States of America, feix@g.clemson.edu, Yongxi Huang, Sandra Eksioglu

We developed a multistage mixed integer programing model that integrates multimodal transport system into a cellulosic biofuel supply chain planning. Strategic decisions on locations/capacities of transshipment hubs, refineries and terminals as well as tactical decisions on system operations such as transporting and storage are optimized in an integrated manner. It is found that compared to single-mode transport system the multimodal system can achieve more economic and environmental benefits.

■ TD62

Mezzanine - 100C

Prediction of Non-stationary Process

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Eunshin Byon, Assistant Professor, University of Michigan, 2773 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, ebyon@umich.edu

Co-Chair: Arash Pourhabib, Research Assistant, Texas A&M University, TAMU 3131, College Station, TX, 77840, United States of America, arash.pourhabib@tamu.edu

1 - Nonstationary System Prediction using Dirichlet Process based Symbolic Transition Analysis

Satish Bukkapatnam, Professor, Oklahoma State University, 322 Engineering North, Oklahoma State University, Stillwater, OK, United States of America, satish.t.bukkapatnam@okstate.edu, Changqing Cheng, Zhenyu (James) Kong, Zimo Wang

Multi-step clustering prediction is investigated using Dirichlet process based symbolic dynamic analysis. Symbolic sequence is constructed based on Dirichlet process clustering. Our case studies show that this approach outperforms conventional models for multi-step clustering prediction for non-stationary systems.

2 - Modeling the Spatio-temporal Dynamics of Local Wind Fields at a Wind Farm

Arash Pourhabib, Research Assistant, Texas A&M University, TAMU 3131, College Station, TX, 77840, United States of America, arash.pourhabib@tamu.edu, Yu Ding, Jianhua Huang

Viable power system operations hinge on accurate short-term wind speed forecast. We present a Stochastic Differential Equation (SDE) model for analyzing local wind fields for the purpose of wind speed forecast. The SDE model takes into account both spatial and temporal dependencies among wind speeds measured at different locations. Using discretization and least square techniques, we solve the proposed SDE and demonstrate its usefulness over time series practice for wind speed forecast.

3 - Allocation of Spares Inventory and Redundant Units Considering Fleet Expansion

Wei Xie, Ph.D. Candidate, University of Arizona, Tucson, AZ, 85721, United States of America, wxie@email.arizona.edu, Tongdan Jin, Haitao Liao

We study a spare parts inventory and redundancy allocation problem in which the product's installed base increases over time. Because the demand for spare parts is non-stationary, an adaptive inventory policy that periodically adjusts the base-stock level is developed to attain the required service level. A stochastic programming model is formulated to minimize the total cost by jointly optimizing the levels of redundancy and inventory.

4 - Adaptive Modeling and Prediction in Time-variant Processes

Eunshin Byon, Assistant Professor, University of Michigan, 2773 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, ebyon@umich.edu, Nattavut Yampikulsak

We develop a new adaptive learning method for a dynamic system where the dependency among variables changes over time. For a nonstationary process with time-varying input-to-output relationship, a single baseline curve may not accurately characterize the system's behavior. We develop a kernel-based, nonparametric regression model that allows the baseline curve to evolve over time, and provides the solution procedure.

■ TD63

Mezzanine - 100D

Multivariate Data Analysis for Quality and Reliability Improvement I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qingyu Yang, Assistant Professor, Wayne State University, 4815 Fourth Street, Detroit, MI, 48202, United States of America, qyang@wayne.edu

1 - Data Fusion for Degradation Modeling and Prognostic Analysis based on a Specified Degradation Model

Kaibo Liu, Ph.D Candidate, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, GA, United States of America, kbliu@gatech.edu, Jianjun Shi

In this talk, we present a methodology for developing a composite health index for better characterizing the performance of a system through the selection and fusion of multiple sensor data based on a specified degradation model. This methodology includes data selection, data processing, and data fusion steps which can lead to an improved prognostic result. Our methodology was evaluated by a degradation dataset of an aircraft gas turbine engine that was generated by C-MAPSS.

2 - Field Failure Prediction Based on Multi-Level Repair and System Usage Information

Yili Hong, Assistant Professor, Virginia Tech, Blacksburg, VA, United States of America, yilihong@vt.edu, Zhibing Xu, William (Bill) Meeker

Repairable systems in the field often receive repair actions at different levels: system, sub-system, and component level. System usage, environmental information, repair information can be available. We develop a multi-level trend renewal process model to describe the event process for the component replacements, which incorporates information from different levels and explains the effects of factors at different levels. A field failure prediction procedure is developed for the proposed model.

3 - Process Modeling and Control Strategies Based on Approximated Gaussian Processes

Chia-Jung Chang, Assistant Professor, The Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16802, United States of America, cchang@psu.edu

Gaussian process provides a powerful methodology for capturing the dynamics of a complicated system. However, the fitted Gaussian process model based on real data may lead to an over complex prediction model which makes it difficult for implementing control strategy to fulfill the purpose of system performance improvement. In this work, we develop a methodology to obtain an approximating Gaussian process model which provides the feasible control ability.

4 - Fracture Failure Analysis of Advanced High Strength Steel by Utilizing Microscopic Properties

Qingyu Yang, Assistant Professor, Wayne State University, 4815 Fourth Street, Detroit, MI, 48202, United States of America, qyang@wayne.edu, Nailong Zhang

Advanced high-strength steels (AHSS) has received increased interest in a large variety of industry applications due to its light-weight structures without compromising safety. The properties of AHSS steel are affected not only by the multi-phase material properties, by also by material microstructure. In this research, we developed an efficient model to analyze the failures of AHSS by utilizing its microscopic properties that are derived from its microscopic images.

■ TD64

Mezzanine - 100E

Energy Information Systems

Sponsor: Information Systems

Sponsored Session

Chair: Sudip Bhattacharjee, Associate Professor, University of Connecticut, 2100 Hillside Road, Storrs, United States of America, sbhattacharjee@business.uconn.edu

1 - Balancing Games: A Comparative Study of Individual and Group Incentives for Grid-Balancing

Ori Marom, RSM Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, omarom@rsm.nl, Sudip Bhattacharjee, Xu Han, Wolf Ketter

One of the most significant challenges for the implementation of smart energy grid is real-time balancing. We conduct a behavioral experiment in which both individuals and groups are asked to incur some inconvenience in order to produce a balanced and coordinated set of actions over time. We compare the performance of individual players and groups of players in two scenarios: (i) when competitor's actions and performance are observed; (ii) when such information is not available.

2 - Autonomous Agents in Future Energy Markets: The 2013 Power Trading Agent Competition

Wolf Ketter, Associate Professor, Erasmus University, Rotterdam School of Management, Rotterdam, Netherlands, WKetter@rsm.nl, John Collins, Markus Peters

Power TAC is a rich, competitive, open-source simulation platform for future retail power markets built on real-world data and state-of-the-art customer models. Its purpose is to help researchers understand the dynamics of customer and retailer decision-making as well as the robustness of proposed market designs. Power TAC invites researchers to develop autonomous electricity broker agents and to pit them against in global competitions. We analyze successful brokers of the 2013 competition.

3 - A Probabilistic Preference Model with Applications to Electricity Tariff Choice

Markus Peters, PhD Candidate, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, peters@rsm.nl, Wolf Ketter

Information systems that make autonomous decisions based on consumers' preferences will play an important role in the smart retail electricity markets of the future. We present a computational preference model that learns unobtrusively from limited data and that quantifies the certainty of its own predictions as input to autonomous decision-making tasks. We evaluate our model on real-world tariff preference data collected through a commercial crowdsourcing platform.

■ TD65

Mezzanine - 100F

Models of Information Diffusion in Social Networks

Cluster: Social Media Analysis

Invited Session

Chair: Tauhid Zaman, Assistant Professor, Massachusetts Institute of Technology, Sloan School of Management, Cambridge, MA, 02139, United States of America, zlisto@mit.edu

1 - A Dynamic Random Graph Approach to HPV Transmission in Adolescent Sexual Networks

Marc D. Ryser, Duke University, United States of America, ryser@math.duke.edu, Kevin McGoff, Evan Myers, David Sivakoff, David Herzog, Rick Durrett

Approximately 5% of all cancers worldwide are caused by infection with the sexually transmitted Human Papilloma Virus (HPV). Acknowledging that sexual network structure and temporal ordering of relationships play a crucial role in HPV transmission, we develop a dynamic random graph model for adolescent sexual networks. Incorporating the HPV infection dynamics, we then use the model to assess efficacy of competing vaccination policies.

2 - Ranking from Pairwise Comparisons

Sewoong Oh, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, swoh@illinois.edu, Devavrat Shah, Sahand Negahban

The question of aggregating pair-wise comparisons to obtain a global ranking over a collection of objects has been of interest for a very long time: be it ranking of online gamers and chess players or aggregating social opinions. In most settings, in addition to obtaining ranking, finding 'scores' for each object is of interest for understanding the intensity of the preferences. We propose an iterative rank aggregation algorithm for discovering scores for objects from pairwise comparisons.

3 - Learning the Dynamics of Social Network Diffusion from Limited Data

Andrew Li, Massachusetts Institute of Technology, 77 Massachusetts Ave., Bldg. E40-130, Operations Research Center, Cambridge, MA, 02139, United States of America, aali@mit.edu, Vivek Farias, Tauhid Zaman

In many real-world settings, the underlying structure of a network is known, but the process on the network is not available and must be estimated from observations. Given an information diffusion process over a network, we consider the problem of learning the process from limited adoption data. We demonstrate conditions on the network structure for such inference to be possible, and we propose efficient learning algorithms which we apply to data from an online marketing campaign on Facebook.

4 - Implicit Information Diffusion Networks on Twitter

Stanislav Nikolov, Twitter, 155 Harriet Street Ste 4, San Francisco, CA, 94103, United States of America, snikolov@twitter.com

We study how a topic spreads on Twitter using a novel way of inferring the diffusion network. Using knowledge of the Twitter follow graph and the timing of tweets, we infer how the topic might have spread from user to user by recording when a user that has mentioned the topic influences some of her followers to mention it a short time later. We investigate the dynamics and statistical properties of such networks and use them to formulate and evaluate models of information diffusion.

■ TD66

Mezzanine - 100G

Two-sided Market

Sponsor: Information Systems

Sponsored Session

Chair: Xiuli He, Assistant Professor, Univeristy of North Carolina-Charlotte, 9201 University City Blvd, BISOM Dept., Charlotte, NC, 28223, United States of America, xhe8@uncc.edu

Co-Chair: Xiajun Amy Pan, University of Florida, PO Box 117169, Gainsville, FL, United States of America, amypan@ufl.edu

1 - Designing Platforms for Supplier Aggregation and Integration

Burcu Tan, Assistant Professor, Tulane University, Freeman School of Business, New Orleans, LA, 70115, United States of America, btan@tulane.edu, Amiya Chakravarty, Geoffrey Parker

We focus on an e-marketplace that matches buyers and suppliers to study the subscription fee and the context-service investment that determine the viability of the marketplace. Although others have studied the basic business-to-business exchange investment problem, this paper is novel because we incorporate heterogeneous complementary externalities between sellers. We characterize conditions for the exchange operator to set fees such that not all suppliers are willing to join.

2 - The Effects of Online Review on Collaborative Service Provision

Haoying Sun, Assistant Professor, Texas A&M University, 320 Wehner Building, Mays Business School, TAMU, College Station, TX, 77843-421, United States of America, hsun@mays.tamu.edu, Lizhen Xu

We study a collaborative service setting where the outcome depends on both the service provider's and the client's effort levels, and the provider can prescribe the client's effort level. The market uses various signals, such as outcomes or/and online reviews, to update its belief about the provider's type. Furthermore, the provider's payoff depends on the market belief. We analyze how the availability of online reviews affects the effort levels of both parties and the outcomes accordingly.

3 - Dynamic Two-Sided Pricing under Sequential Innovation

Xiajun Amy Pan, University of Florida, PO Box 117169, Gainsville, FL, United States of America, amypan@ufl.edu, Mei Lin

Many two-sided platforms offer innovative hardware products, which improve in quality and enter the marketplace sequentially. We analyze the impact of reductions in future production cost and network effects on a monopolist's dynamic pricing strategies for a durable good facing strategic buyers.

4 - Piracy Control in Two-sided Markets

Xiuli He, Assistant Professor, Univeristy of North Carolina-Charlotte, 9201 University City Blvd, BISOM Dept., Charlotte, NC, 28223, United States of America, xhe8@uncc.edu, Sungjune Park, Peiqin Zhang

This study investigates the piracy control in two-sided markets. The third-party platform providers generate revenues both in advertising and content market. We study the optimal prices for the content and advertising market and the level of piracy control for the platform providers.

■ TD67

Mezzanine - 100H

Joint Session DAS/BOM: Decision Analysis and Behavioral Operations

Sponsor: Decision Analysis & Behavioral Operations Management

Sponsored Session

Chair: Yael Grushka-Cockayne, University of Virginia, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, GrushkaY@darden.virginia.edu

1 - Bounded Rationality and Learning in the Economic Order Quantity Setting

Kay-Yut Chen, Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA, 94304, United States of America, kayyutchen@yahoo.com, Diana Wu

While the Experience Weighted Attraction (EWA) model has success in explaining decision behavior in operations setting, it assumes the setting is static. We extend the EWA model to capture changing environments and allow individuals to learn from "similar" environments. The model is applied to an EOQ setting where the parameters (e.g. holding cost) are changing and we shows that this "learning from similar experience" effect is significant in a substantial fraction of the subjects.

2 - Carrot vs. Stick: The Effectiveness of Contract Mechanisms on Incentivizing Supplier Innovation

David Wuttke, EBS University, Konrad-Adenauer-Ring 15, Wiesbaden, Germany, david.wuttke@ebs.edu, Karen Donohue, Enno Siemsen

Using a combination of analytical models and laboratory experiments, we study the effectiveness of buyer contract mechanisms, including breach penalties and innovation rewards, on incentivizing product innovation at the supplier level. Our results provide insight into how the mechanisms can be altered to better account for supplier-specific behavior.

3 - Information Reliability in Supply Chains: The Case of Multiple Retailers

Eirini Spiliotopoulou, PhD Candidate in Supply Chain Management, MIT-Zaragoza International Logistics Program, Edificio Nayade 5, C/ Bari 55 - Plaza, Zaragoza, Spain, espiliotopoulou@zlc.edu.es, Karen Donohue, Mustafa Cagri Gurbuz

Multiple retailers form a pooling coalition and delegate inventory management to a benevolent central planner (CP). Each retailer faces uncertain demand and has private information about it due to his proximity to the market. We focus on whether reliable demand information sharing occurs between retailers and the CP. We study analytically and experimentally the impact of a) competition for common inventory and b) market uncertainty on information distortion, trust and supply chain efficiency.

4 - Overcoming the Planning Fallacy

Yael Grushka-Cockayne, University of Virginia, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, GrushkaY@darden.virginia.edu, Bert De Reyck, Ioannis Fragkos, Daniel Read

How an organization manages its projects is critical to its success. Yet, firms routinely experience the Planning Fallacy: projects are delivered late, over-budget, or with reduced scope. We investigate project performance and describe our work with UK Network Rail on how to plan for the planning fallacy.

■ TD68

Mezzanine - 100I

Topics in Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Victor Richmond Jose, Georgetown University, McDonough School of Business, Washington, DC, United States of America, vrj2@georgetown.edu

1 - Correcting Partition Dependence and Carryover Biases in Subjective Probabilities: A Web Survey

Venkat Prava, PhD Student, The Johns Hopkins University, Baltimore, MD, United States of America, vprava1@jhu.edu, Melissa Kenney, Robert Clemen, Ben Hobbs

A model-based approach to correcting partition dependence (PD)and carryover bias in subjective probabilities is tested using responses from a web-based questionnaire involving 1500 subjects. We model assessed probabilities as a convex combination of anchors and individual's unbiased probabilities. We found that ordering of questions can be used to decrease carryover and questionnaire format can be used to reduce PD bias.

2 - An Interactive Bayesian Method to Sort Alternatives into Preference Categories

Canan Ulu, University of Texas at Austin, McCombs School of Business, Austin, TX, United States of America, Canan.Ulu@mccombs.utexas.edu, Tom Shively

We present a method that interactively places alternatives into preference categories (e.g. most, somewhat and least preferred). We assume the decision maker has a linear value function and her responses are prone to error. In each step of the algorithm, we ask the decision maker to place an alternative in a category and using this information, we update our estimate of her value function via MCMC. We compare our method to other algorithms in the literature that assume away response errors.

3 - On an Automated Market Maker with Price Convergence Guarantees

Arthur Carvalho, Ph.D. Candidate, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, a3carval@uwaterloo.ca, Kate Larson, Stanko Dimitrov

We consider a prediction market in which agents trade in rounds. During each round an agent can only trade up to a certain number of contracts. In such a market, the logarithmic market scoring rule's price converges to the median of agents' private information for an odd number of agents, and to a point in the so called median interval for an even number of agents. We also show that the equilibrium price does not change even when agents revise their beliefs using price data.

4 - Anticipate Analysis, Information Systems, and Social Responsibility Driven Decision Analysis

Orhan Güvenen, Professor, Bilkent University, Bilkent University DSEE, FEASS, Z-03 06800 Bilkent, Ankara, Turkey, gorhan@bilkent.edu.tr

In dynamic systems the analysis of any problem in time t and its evolution for the future, dominantly can be explained with an acceptable error margin. A non linear anticipative analysis, through the dominant trends of information systems, endogenizing socio-economic responsibility, may converge to an estimation of the alternative costs of not solving the problem in time t. The research analyses this approach and its value added to decision analysis.

■ TD69

Mezzanine - 100J

Retail Management II

Contributed Session

Chair: Guangzhi Shang, PhD Candidate, University of South Carolina, 1705 College Street, Columbia, sc, 29208, United States of America, guangzhi.shang@grad.moore.sc.edu

1 - Price Discounts in Retailing: Fixed Versus Purchase-Based Percentages

Monire Jalili, PhD Student, University of Oregon, Lundquist College of Business, Eugene, OR, 97403, United States of America, mjalili@uoregon.edu, Michael Pangburn

Retailers commonly offer a discount off regular price in the form of a fixed percentage reduction (e.g., 20% off). In contrast, some retailers apply a credit based on the customer's prior purchase. We contrast the efficacy of these two discounting tactics to better understand conditions under which prior-purchase based discounts may outperform standard fixed-percentage discounts.

2 - Salespersons' Empathy: A Systematic Literature Review and Research Agenda

Dominik Burger, MA, Swiss Research Institute for Small Business and Entrepreneurship, Dufourstrasse 40a, St. Gallen, 9000, Switzerland, dominik.burger@unisg.ch, Alexander Fust, Urs Fueglistaller

Salespersons' empathy has received recognition by scholars and sales representatives. Despite its importance, definitions and conceptualizations of salespersons' empathy are rather heterogeneous. Thus, we used the method of systematic literature review to analyze 42 empirical articles. A research agenda focusing on salespersons' empathy's measurement, antecedents and moderators as well as effects on performance and relationship outcomes is presented to advance the field.

3 - Analysis and Forecasting of Demand during Promotions for Perishable Items

Karel van Donselaar, Assistant Professor, Eindhoven University of Technology, PO Box 513, Eindhoven, 5600 MB, Netherlands, k.h.v.donselaar@tue.nl, Ad de Jong, Jordi Peters

In this paper we analyze the impact of relative price discounts on product sales for perishable items in a retail environment and we develop and test a model to forecast promotional demand. This is the first study which analyzes threshold and saturation effects for perishable items and the impact of product and demand characteristics based on a large empirical dataset consisting of a variety of perishable items from the product categories Deserts, Dairy Drinks, Cold Cuts and Salads.

4 - Store-wide Shelf Space Optimization to Maximize Impulse Buying

Tulay Varol, University of Massachusetts Amherst, 121 Presidents Dr., Office # SOM 231, Amherst, MA, 01002, United States of America, tulayvarol@gmail.com, Bacel Maddah, Ahmed Ghoniem

We consider the problem of optimizing shelf space allocation to product categories to maximize impulse buying throughout a retail store. A novel mixed-integer (nonlinear) formulation is presented along with promising computational results based on real and simulated data.

5 - On the Time Window of Consumer Return Policies: Theory and Empirical Evidence

Guangzhi Shang, PhD Candidate, University of South Carolina, 1705 College Street, Columbia, sc, 29208, United States of America, guangzhi.shang@grad.moore.sc.edu

We develop an econometric model that simultaneously explains consumer's experience duration and return probability, which are in turn used for predicting return quantity in a given time period. Our econometric model also offers the opportunity to test hypotheses on the key drivers of consumer returns, providing insight for retailer's buyer assistance programs.

■ TD70

Mezzanine -101A

Aviation Applications Section: Keynote Presentation

Sponsor: Aviation Applications

Sponsored Session

Chair: Thomas Vossen, University of Colorado at Boulder, 995 Regent Dr, Boulder, CO, 80309, United States of America, Vossen@Colorado.EDU

1 - Next Generation Tools for Airlines & Customers: Cross-Leveraging IT & OR

Theresa Wise, Delta Airlines, Atlanta, GA, United States of America

Theresa Wise, senior vice president and chief information officer of Delta Air Lines will present a keynote address entitled "Next Generation Tools for Airlines & Customers: Cross-Leveraging IT & OR.

■ TD71

Mezzanine -101B

Game Theory Applications II

Contributed Session

Chair: Banafsheh Behzad, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, United States of America, behzad1@illinois.edu

1 - A Cork Model for Parking

Giovanni Crespi, Associate Professor, University of Valle d'Aosta, Loc. Grand Chemin, 73/75, Saint-Christophe, AO, 11020, Italy, g.crespi@univda.it, Marco Alderighi

We apply a bottleneck approach to the problem of finding a parking lot within a parking area located at destination. Our model is slightly different from standard bottleneck ones, which involve congestion of traffic along a journey, with a constant flow along it. In our proposal, the bottleneck is located at the end of the journey and the flow thorough it is reduced by newcomers. As in the literature cruising for on street parking, we study the role of pricing to improve social utility.

2 - Impact of SaaS on Patching and Software Defects

Zhe (James) Zhang, UC Irvine, UC Irvine, Irvine, CA, United States of America, zhez1@uci.edu, Vidyanand Choudhary

A key difference between traditional on-premise software and SaaS is that the users are responsible for running on-premise software whereas the vendor is responsible for running SaaS software. We show that the SaaS vendor releases the software earlier with more defects, and yet patches fewer defects than the traditional software vendor. We also find that the number of defects after patching in the SaaS model is lower than the socially efficient outcome, but is higher than the on-premise model.

3 - Bertrand-Edgeworth-Chamberlin Competition: A Vaccine Pricing Model For Pediatric Immunization

Banafsheh Behzad, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, United States of America, behzad1@illinois.edu, Sheldon Jacobson, Matthew Robbins

The United States pediatric vaccine market is examined using Bertrand-Edgeworth-Chamberlin price competition. The proposed game captures oligopolistic interactions between symmetric, capacity constrained firms in a differentiated, single-product market. Nash equilibrium provides a consistent solution methodology for describing the pricing behavior of the firms. Results indicate that unique pure strategy equilibrium exists in the case where the capacities of the firm are at their extremes.

4 - An Exact Algorithm for Bi-level Mixed Integer Programs

Bo Zeng, University of South Florida, 4202 East Fowler Avenue, ENC2400, Tampa, FL, 33620, United States of America, bzeng@usf.edu

We consider a general leader-follower bi-level mixed integer program where both levels have discrete variables. Through its tri-level equivalent reformulation, we present a decomposition algorithm, using the previously developed column-and-constraint generation method, to derive an optimal solution. Numerical results will be presented to show the algorithm performance.

■ TD72

Mezzanine -101C

Forecasting

Contributed Session

Chair: Chris Tofallis, Associate Professor of Decision Science, University of Hertfordshire Business School, Business School, College Lane, Hatfield, AL10 9AB, United Kingdom, c.tofallis@herts.ac.uk

1 - The Impact of Forecasting Errors on Warehouse Labor Efficiency: A Case Study in Consumer Electronics

Rommert Dekker, Erasmus University Rotterdam, Burg. Oudlaan 50, Rotterdam, Netherlands, rdekker@ese.eur.nl

In this paper we investigate the relation between labor requirements forecasting and labor efficiency through a case study in a consumer electronics warehouse. From a statistical analysis of two years of data we observe that management systematically overestimates labor requirements. Yet it also appears over forecasting leads to a better labor efficiency as most appropriate manpower is retained in that way.

2 - Modeling Zero-inflated Customer Responses to Display Ads/Items in Online Social/Commercial Marketing

Jingjing Guan, PhD candidate, City University of Hong Kong, P7701, Dept of Management Sciences, AC1, Tat Chee Avenue , Kowloon Tong, Hong Kong SAR, Hong Kong - PRC, jjguan@cityu.edu.hk

Display ads/items in online social/commercial marketing frequently get zero responses due to limited attention from customers. I propose a time varying Multilevel Zero-Inflated Poisson regression approach to forecast customer behaviors with variables on webpage design, customer and supplier attributes, and delivery methods. A Bayesian MCMC method of computational convenience for big data is introduced to obtain maximum likelihood estimations. This approach outperforms logistic regression etc.

3 - What's the BFD about Mike Gilleland's FVA?

Dave Wehling, Globe University, IDS tower, Minneapolis, United States of America, dwehling@globeuniversity.edu

This is to refute Mike's often heard claims about the strengths of Forecast Value Added Analysis (FVA). The BFD in the title references Mike's blog of the same name. Mike wrote a best-selling forecasting book titled The Business Forecasting Deal. Chapter four deals with FVA. He has a widely read forecasting blog in which he often espouses FVA. The purpose of this talk is to show where Mike misses the mark.

4 - An Investigation of Diffusion Models in a Saturated Mobile Phone Market

Byeong-Yun Chang, Ajou University, San 5, Woncheon-dong, Yeongtong-gu, Suwon, Korea, Republic of, bychang@ajou.ac.kr

This research develop a extended Lotka-Volterra (LV) and examine a performance of it for the saturated mobile phone market of the Republic of Korea. A three species LV model is developed and applied to Korean mobile phone service providers in terms of competitive impact. Fitting the historical data of the Korean mobile communication service market, the goodness of fit of the three species LV model in the case of competition between three companies shows good performance.

5 - A Superior Alternative to Mean Absolute Percentage Error in Forecasting

Chris Tofallis, Associate Professor of Decision Science, University of Hertfordshire Business School, Business School, College Lane, Hatfield, AL10 9AB, United Kingdom, c.tofallis@herts.ac.uk

When MAPE is used to estimate parameters in a prediction model, most of the predictions will be too low. We explain why this happens. An alternative relative error measure is proposed which overcomes this problem. The associated regression model involves a multiplicative error. It predicts the geometric mean, and possesses a form of unbiasedness which is appropriate for relative accuracy. This therefore seems to be preferable to MAPE as an accuracy measure for comparing prediction methods.

Wednesday, 8:00am - 9:30am

■ WA01

Level 2 - Room 200A

Portfolio Optimization III

Cluster: Optimization in Finance

Invited Session

Chair: Victor DeMiguel, London Business School, Regents Park, London, United Kingdom, avmiguel@london.edu

1 - Robustness to Dependency in Portfolio Optimization using Overlapping Marginals

Karthik Natarajan, Associate Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, natarajan_karthik@sutd.edu.sg, Xuan Vinh Doan, Xiaobo Li

In this paper, we develop a distributionally robust portfolio optimization model to dependency structures. For a Frechet class of distributions with overlapping marginals, we show that the portfolio optimization problem is efficiently solvable with linear programming. Lastly, we use a data-driven approach using real financial data to identify the Frechet class of distributions and then optimize the portfolio over this class of distributions.

2 - Optimal Multiperiod Portfolio Selection with Trading Costs and Parameter Uncertainty

Alberto Martin-Utrera, University Carlos III of Madrid, Calle Madrid, 126, Getafe, Madrid, 28903, Spain, amutrera@est-econ.uc3m.es, Victor DeMiguel, Javier Nogales

We address the effects of parameter uncertainty in multiperiod portfolio selection in the presence of transaction costs. We propose a novel four-fund portfolio that takes parameter uncertainty optimally into account. This portfolio diversifies the effects of estimation risk across four different funds and mitigates the impact of parameter uncertainty in the investor's expected utility. Finally, we characterize the out-of-sample performance of four-fund portfolios in an empirical application.

3 - Multiperiod Portfolio Optimization with General Transaction Costs

Mei Xiaoling, Universidad Carlos III de Madrid, Department of Statistics, Avda. de la Universidad, 30, Leganés, 28911, Spain, xmei@est-econ.uc3m.es, Javier Nogales, Victor DeMiguel

We analyze the optimal portfolio policy for a multiperiod mean-variance investor who faces multiple risky assets, and is subject to general transaction costs. We find the no-trade region is a parallelogram for proportional transaction costs. For market impact costs, the optimal trading strategy is characterized by a superellipse that shrinks along the horizon, which may result in trading occurring throughout the horizon. Illustrative numerical results are provided.

■ WA02

Level 2 - Room 200B

Nonlinear Optimization and Its Application

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Xi Bai, PhD Candidate, Lehigh University, 461 Montclair Ave., Bethlehem, PA, 18015, United States of America, xib210@lehigh.edu

1 - Path-finding Algorithms for Complex Dynamic Systems

Alvaro Maggiar, PhD Candidate, Northwestern University, 2145 Sheridan Road, IEMS, Evanston, IL, 60201, United States of America, alvaro.maggiar@u.northwestern.edu, Irina Dolinskaya

The motion of unmanned vehicles subject to external factors, such as wind, results in complex dynamics that need to be taken into account for efficient path-planning. By formulating the problem of finding a fastest path between two configurations in direction-dependent media as a non-linear program, we are able to derive an algorithm that implements the results. We illustrate its application to naval and aerial vehicles.

2 - Modeling Noisy Functions via Regression and its Applications to Derivative-Free Optimization

Ruobing Chen, Lehigh University, 27 Memorial Drive West, Bethlehem, PA, 18015, United States of America, ruc310@lehigh.edu, Katya Scheinberg

Problems with numerical noise form the key domain of Derivative-Free Optimization (DFO) algorithms and response surface methodology. We propose a general DFO algorithm for noisy problems. This algorithm utilizes regularized regression models that leverage between model complexity and the level of noise in a function. For controllable noise, an accuracy adjustment procedure is employed to dynamically reduce noise level. Numerical studies illustrate the effectiveness of the proposed techniques.

3 - An Augmented Lagrangian Framework for Risk Parity Optimization

Xi Bai, PhD Candidate, Lehigh University, 461 Montclair Ave., Bethlehem, PA, 18015, United States of America, xib210@lehigh.edu, Katya Scheinberg

The risk-parity optimization problem aims to find such portfolio that the contributions of risk are equally weighted. In this talk, we form a general model for risk-parity portfolio construction and propose an augmented Lagrangian framework to solve it. Numerical experiments indicate the effectiveness of our technique in terms of both speed and accuracy.

■ WA03

Level 2 - Room 200C

Joint Session OPT Global/ICS: Global and Nonlinear Optimization

Sponsor: Optimization/Global Optimization and Mixed-Integer Nonlinear Programming & Computing Society

Sponsored Session

Chair: Ted Ralphs, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, ted@lehigh.edu

1 - Global Optimization with Non-polyhedral Convex Envelopes

Sreekanth Rajagopalan, Graduate Student, Carnegie Mellon University, 5000 Forbes Avenue, Doherty Hall 3110, Pittsburgh, PA, 15213, United States of America, sreekanr@andrew.cmu.edu, Aida Khajavirad, Nick Sahinidis

Central to the efficiency of deterministic global optimization algorithms is construction of sharp and cheap convex relaxations. In a recent work, Khajavirad and Sahinidis presented algebraic expressions for the convex envelopes of various functional forms that are building blocks of nonconvex optimization problems. We propose a cutting plane generation technique based on supporting hyperplanes of the proposed convex envelopes, and present extensive computational results.

2 - A Fast Heuristic Method for Global Optimization and MINLP

John Chinneck, Professor, Carleton University, Systems and Computer Engineering, 1125 Colonel By Drive, Ottawa, On, K1S 5B6, Canada, chinneck@sce.carleton.ca, Mubashsharul Shafique

Our multi-start heuristic for global nonlinear optimization has these steps: random initial points, rapid movement towards feasibility, clustering the near-feasible points to identify disjoint feasible regions, a simple heuristic for improving the best point in each cluster, and a local optimizer. The method is parallelizable, well-suited to very large models, and fast. It is extended to MINLP by adding spatial and integer branching to return a solution using very few local optimizer launches.

3 - Bounds on the Size of Quadratizations of Pseudo-Boolean Functions

Endre Boros, Distinguished Professor, Rutgers University Center for Operations Research, 640 Bartholomew Road, Piscataway, NJ, 08854, United States of America, boros@rci.rutgers.edu, Martin Anthony, Yves Crama, Aritanan Gruber

There are several techniques to reduce a nonlinear binary minimization problem to a quadratic one. It is however not clear how large the resulting quadratic problems can be. In this talk we consider all possible quadratizations(not necessarily depending on a particular construction), and prove sharp lower and upper bounds on the size of the resulting quadratic functions. Our upper bounds are in fact constructive, resulting in new quadratization algorithms.

4 - A Fast Sub-gradient Descent Approach for Sparse Inverse Covariance Selection Model

Yuqi Sun, Industrial and Manufacturing system Engineering, the Pennsylvania State University, 240 Leonhard, University Park, United States of America, yus139@psu.edu, Hongcheng Liu, Ke Han, Tao Yao

We propose a fast sub-gradient descent method with flexible step size to solve a maximum likelihood problem with l_1-norm penalty. By proving the strongly convexity of the primal problem, our proposed method yields an O(log(1/epsilon)) iteration complexity. By reducing per-iteration cost, this method can significantly reduce the computational efforts compared with existing approaches.

■ WA04

Level 2 - Room 200D

Theory of Mixed Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Alberto Del Pia, Post Doctoral Researcher, ETH Zurich, ETH Zürich - HG G 21.3, Rämistrasse 101, Zurich, 8092, Switzerland, alberto.delpia@gmail.com

1 - The 4/3 Conjecture for Fractional 2-Matching Instances of the Traveling Salesman Problem

Caleb Fast, Rice University, PO Box 1892, Comp & Applied Math MS-134, Houston, TX, 77251, United States of America, calebfast@gmail.com

This talk presents a 4/3 bound on the integrality gap of the Held-Karp relaxation of the Traveling Salesman Problem for certain fractional 2-matching cost instances. These instances have been conjectured to attain the integrality gap for the general problem. Thus, this work provides an approach to proving the 4/3 conjecture for the Held-Karp relaxation and a direction for improving on Christofides' 3/2 approximation heuristic.

2 - Reformulation-induced Cuts

Frederik von Heymann, Delft University of Technology, Mekelweg 4, Delft, 2628CD, Netherlands, f.j.vonheymann@tudelft.nl, Karen Aardal, Andrea Lodi, Laurence Wolsey

Given a rational affine subspace, we can use a well-known technique to reformulate the problem of finding non-negative integer points in the subspace to the problem of finding elements of the kernel lattice of the equations describing the subspace, that are contained in a certain polytope. We compare how classical cutting planes translate between these formulations from a theoretical viewpoint, and give an indication of how this technique performs in practice.

3 - Optimality Certificates in Mixed Integer Programming: From Branch and Bound to Cutting Planes

Babak Moazzez, Carleton University, 4270 HP, 1125 Colonel By Drive, Ottawa, ON, K1S5B6, Canada, bmoazzez@math.carleton.ca

Having an MILP and its optimal solution in hand, generating a certificate using the branch and bound tree has been the main goal of our research. We have done this using disjunctive programming, split inequalities and polyhedral study for MILPs and corresponding valid inequalities. The certificate we generate is a (subadditive) dual vector which will give us the optimal value using subadditive generator functions.

■ WA05

Level 2 - Room 200E

Approximate Dynamic Programming

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Peng Sun, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27705, United States of America, peng.sun@duke.edu

1 - Quadratic Approximation of L-natural Convex Value Functions, with Applications in Inventory and Pricing Management Problems

Kai Wang, Duke University, Durham, NC, United States of America, kai.wang@duke.edu, Peng Sun, Paul Zipkin

We propose a quadratic approximation of L-natural convex value functions that can be used in an approximate linear programming framework for large scale dynamic programs. The approached is applied numerically to three types of problems with L-natural convex value functions: inventory control with lost sales, perishable product inventory, and joint inventory and pricing problems, and produce superior results.

2 - Shape Constrained Estimation of Value Functions in Dynamic Programing

Mohammad Mousavi, Stanford University, 140 Ayrshire Farm Lane#103, Stanford, CT, 94305, United States of America, mousavi@stanford.edu

We present a non-parametric method to estimate the value function in a Markov Decision process (MDP) by a convex estimator. The value function is well-known to be convex for a wide range of MDP problems. For this class of problems, we establish a non-parametric method to approximate the value function.

3 - A Bayesian Graphical Generalization for the Black-Litterman Model
Shea Chen, University of California-Berkeley, Berkeley, CA, United States of America, shea.chen@gmail.com, Andrew Lim

In finance, the Black-Litterman model is a Bayesian method used to combine investor opinions with the market portfolio to obtain an estimate for the future returns of assets. We generalize the Black-Litterman model to account for uncertainty in the investor and the market equilibrium estimate. The posterior distribution of this model is difficult to obtain analytically, but can be sampled using Gibbs' sampling. This method can yield Markowitz portfolios that are robust to inaccuracies in the Black-Litterman model, such as investor bias or incorrect market portfolios.

■ WA06

Level 2 - Room 200F

Network Analysis

Sponsor: Optimization/Networks

Sponsored Session

Chair: Bahar Cavdar, Georgia Institute of Technology, 755 Ferst Drive, NW, Main Building, Office: 447, Atlanta, Ge, 30332, United States of America, baharca@gatech.edu

1 - Information Quality and Competition in the Supply Chain Network
Deanna Kennedy, Assistant Professor, University of Washington Bothell, 18115 Campus Way NE, Bothell, WA, 98028, United States of America, dkennedy@uwb.edu, Qiang Qiang, Zugang Liu, Trisha Anderson

This paper focuses on competition and the quality of information shared among supply chain players. We investigate the dynamics between the firms in a general supply chain network. We model the network to capture interactions among various information quality dimensions including information sharing, information distortion, and accuracy. We derive the equilibrium conditions and use numerical examples to provide managerial implications.

2 - Incremental Network Design with Maximum Flows
Dmytro Matsypura, The University of Sydney, Rm 478 Merewether Building H04, Sydney, 2203, Australia, dmytro.matsypura@sydney.edu.au, Thomas Kalinowski, Martin Savelsbergh

Network infrastructure upgrades are a common phenomenon and typically occur over time due to various constraints. We introduce a class of incremental network design problems and focus on one of its variants: incremental network design with maximum flows. We consider the complexity of the problem, analyse the performance of natural heuristics, derive approximation algorithms, and study integer program formulations.

3 - Traveling Salesman Tour Length Estimation on General Graphs
Bahar Cavdar, Georgia Institute of Technology, 755 Ferst Drive, NW, Main Building, Office: 447, Atlanta, Ge, 30332, United States of America, baharca@gatech.edu, Joel Sokol

There are many models in the literature to estimate the optimal Traveling Salesman tour length. However, these models are engineered for uniform random graphs. What if we have a general graph where the nodes follow a specific pattern? We develop a new tour length estimation model which captures the different node scatter than uniformity and discuss the implementation of the model into heuristic algorithms to improve the tour quality.

■ WA07

Level 2 - Room 200G

Stochastic Programming in Financial Portfolio Management

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Alan King, IBM, PO Box 218, Yorktown Heights, NY, United States of America, kingaj@us.ibm.com

1 - Stochastic Portfolio Optimization under Regime-based Firm Strength Scenarios
Chanaka Edirisinghe, Professor, University of Tennessee, 233 Stokely Management Center, 916 Volunteer Blvd, Knoxville, TN, 37996, United States of America, chanaka@utk.edu

A stochastic optimization model under regime-switching market uncertainty is proposed to manage stock portfolios. Investments are selected based on relative firm strengths using quarterly financial statements, and consistent with specific regime scenarios. The regime-switching model is combined with the firm-strength metric to test the performance of a two-quarter stochastic programming model. The out-of-sample results are used to demonstrate the superiority of the methodology.

2 - Using Options Market Data in Asset Liability Management
Alan King, IBM, PO Box 218, Yorktown Heights, NY, United States of America, kingaj@us.ibm.com

In this talk we discuss a framework to calibrate contingent assets and liabilities to options market data. The calibration framework has a natural interpretation as a utility function, and the output is a risk-neutral measure that can be used to mark the contingent assets and liabilities to market data. We discuss how this framework can be applied to asset-liability management problems.

■ WA08

Level 2 - Room 200H

Computational Optimization

Sponsor: Computing Society

Sponsored Session

Chair: David Morrison, University of Illinois, Urbana-Champaign, 201 N Goodwin Ave., Urbana, IL, United States of America, morris50@illinois.edu

1 - On Solving Convex Optimization Problems with Linear Ascending Constraints
Zizhuo Wang, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, zwang@umn.edu

We propose two algorithms for solving convex optimization problems with linear ascending constraints. When the objective function is separable, we propose a dual method which terminates in finite iterations. The worst case complexity of our dual method improves over the best-known result for this problem. We then propose a gradient projection method to solve a more general class of problems. Numerical experiments show that both our algorithms work very well in test problems.

2 - Mixed Convexity and Optimization Results for an (S-1,S) Inventory Model with Time Limit on Backorders
Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu, Hillel Kumin

In this paper, strong computational mixed convexity results are obtained for the Erlang delay and loss formulae by applying a new convexity technique. This new technique is applied to obtain computational joint mixed variable convexity and optimization results for a cost function associated with an (S-1,S) inventory model suggested by Das (1977).

3 - Modeling Agent Auctions in the Two Dimensions of Price and Quantity
Barin Nag, Professor, Towson University, E-Business & Technology Management, Towson, MD, 21252, United States of America, bnag@towson.edu, Sungchul Hong, Dong-qing Yao

In agent based multi-period auction trading, inventory costs and trading penalties affect two dimensional decisions of price and quantity to trade or carry over. Cooperation and collaboration between buyer agents and seller agents respectively facilitate trades. Heuristic algorithms implementing a mathematical model presented demonstrate the effectiveness in a simulation experiment.

4 - On the Complexity and Solution of Inverse Mixed Integer Linear Programs
Aykut Bulut, Lehigh University, 200 W Packer Avenue, Bethlehem, PA, 18015, United States of America, ayb211@lehigh.edu, Ted Ralphs

Inverse optimization problem is that of determining values of the parameters of an optimization problem that will make a given solution optimal and that are closest to a given set of nominal values. We consider an inverse MILP in which the parameters to be varied are objective function coefficients. We discuss the complexity of this problem and propose a framework for solving it. We study the effect of problem parameters and other properties of the instance and class on practical running times.

■ WA09

Level 2 - Room 200I

Topics in Analytics

Sponsor: Analytics Section

Sponsored Session

Chair: Michael Gorman, Professor, University of Dayton, 300 College Park, Dayton, OH, 45469, United States of America, michael.gorman@udayton.edu

Co-Chair: Zahir Balaporia, Director, Intermodal Operations, Schneider National, 3101 S. Packerland Drive, Green Bay, WI, 54313, United States of America, balaporiaz@schneider.com

1 - The Progression of Analytics in Motor Racing – In The Beginning

Karl Kempf, Intel Corporation, Phoenix, AZ, United States of America, karl.g.kempf@intel.com

When I arrived in the offices of the Ferrari Formula One Racing team, I was surprised to find that the total data set I was given to work with was lap times and driver comments. Three years later the car was fully instrumented, with useful models at home base and trackside, and microprocessors were on the car doing interesting things as it sped around the track. I will recount the high points (and the low ones) in that journey that has turned out in hindsight to be just the beginning.

2 - Energy Program Targeting: Data and Actions

Adrian Albert, PhD Candidate, Stanford University, 350 Serra Mall, Stanford, CA, 94305, United States of America, adalbert@stanford.edu

What customers should an energy utility enroll in their energy efficiency and demand-response programs? We present methodology for profiling customers' usage from large amounts of high-resolution sensor ("smart meter") data. We develop a targeting model expressed as an integer optimization problem that uses consumption characteristics to select the best subset of customers to achieve set efficiency targets. Understanding consumption patterns greatly improves expected program performance.

3 - Academic Response to the Analytics Wave: Taking Stock in Analytics Programs

Michael Gorman, Professor, University of Dayton, 300 College Park, Dayton, OH, 45469, United States of America, michael.gorman@udayton.edu, Ronald Klimberg

We collected information on 40 different programs touting an "Analytics" focus and report on the offerings. In some sense, without defining it, analytics can be characterized inductively by the topics covered in such offerings. We describe UG, MBA concentrations, certifications, and MS-Analytics programs topical coverage and draw conclusions.

■ WA10

Level 2 - Room 200J

Joint InformEd/Analytics: Panel Discussion: Teaching Data Mining

Sponsor: INFORM-ED

Sponsored Session

Chair: Susan Palocsay, Professor, James Madison University, CIS & Bus. Analytics Dept, Harrisonburg, VA, 22807, United States of America, palocssw@jmu.edu

1 - Panel on Teaching Data Mining

Moderator: Susan Palocsay, Professor, James Madison University, CIS & Bus Analytics Dept, Harrisonburg, VA, 22807, United States of America, palocssw@jmu.edu, Panelists: James Cochran, Ronald Klimberg, Virginia Miori, Stephen Powell, Galit Shmueli

This panel will discuss various aspects of teaching data mining at the undergraduate and graduate levels. We will cover a wide range of pedagogical issues including pre-requisite skills, topic coverage, course materials, software, and assessments. We will also examine the intersection of data mining with traditional statistics and management science education in the context of business analytics.

■ WA11

Level 2 - Room 201A

Social Networks in Operations Management and Marketing

Contributed Session

Chair: Fethullah Caliskan, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, fcaliska@mail.usf.edu

1 - Social Network as a Knowledge Service Provider

Shlomo Mark, Chair of Software Engineering Department, Ashdod Campus and Head, Negev Monte Carlo research Center – NMCRC, SCE, Bialik 36, Beer-Sheva, Israel, marks@sce.ac.il, Tammi Shalev, Guy Shilon, Adi Wolfson, Dorith Tavor

Sustainable processes are processes that balance the needs of the present without compromising the ability of future generations to meet their own needs. The Sustainability as Service Science model (S^3) presents a novel perspective to describes the relationship between sustainability and services in the framework of service science. This study presents a framework in the form of social network as a service provider for 'information to knowledge' process as part of the decision making process.

2 - Social-sharing of Durable Goods: Pricing and Profits

Hendrarto Supangkat, Illinois Institute of Technology, 10 West 35th Street, 18th Floor, Chicago, IL, 60616, United States of America, hsupangk@hawk.iit.edu, Jiong Sun

We study the impact on sellers' pricing and profits when consumers purchase and share durable goods through a network of acquaintances. We find that such sharing can benefit the seller when the group size is not too large, and sellers may prefer a heterogeneous network when the congestion risk is high. We offer other insights that differ from sharing information goods.

3 - The Impact of Collaboration Networking Formations on Invention Performance

Fethullah Caliskan, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, fcaliska@mail.usf.edu, Kingsley A. Reeves, Irene Zubillaga Lopez

Alliance network of organizations is obtained using a national database where organizations' R&D and production joint ventures are reported. Utilizing social network analysis methods, we assessed the impact of network embeddedness metrics on individual and collective invention performance (as measured by number of patents). Certain metrics predominantly predict higher inventive performance. Effective networking strategies may provide an advantageous position for a higher inventiveness.

■ WA12

Level 2 - Room 201B

Financial Markets: Monitoring and Assessment

Contributed Session

Chair: Mark Paddrik, PhD Candidate, University of Virignia, 151 Engineer's Way, Charlottesville, VA, 22904, United States of America, mp3ua@virginia.edu

1 - Study on the Venture Capital Contract Based on Overconfidence and Supervision Mechanism

Zha Bo, PhD, School of Management, Xi'an Jiao Tong University, P.O.Box1851 Xiëan Jiao tong University, Xi'an, China, zhabo127127@sina.com, guo ju-e

Combining entrepreneurs' overconfidence with venture capitalists' supervision, we establish principal-agent relationships among venture capitalist, bank and entrepreneur, prove that there exist the critical value of venture capitalists' supervision, then we analyze the impact of overconfidence and supervision on the relationships among venture capitalist, bank and entrepreneur.

2 - Forecast of Dynamic Time-to-Event Duration in Business Processes

Nan Shao, Research Staff Member, IBM TJ Watson Research Center, 1101 Kitchawan Rd. Route 134, Yorktown Heights, NY, 10598, United States of America, nanshao@us.ibm.com, Jonathan Hosking

A practical solution is proposed to the forecasting of the duration of business processes such as loan or patent applications. The distribution of duration may change over time, so recent data are more relevant for forecasting. However, a large proportion of recent processes are still ongoing, so the data are censored and contain limited information. The solution combines nonparametric estimation of distributions from censored data and time series forecasting of the longer durations.

3 - Monitoring Financial Market Behavior through a Markov Model
Mark Paddrik, PhD Candidate, University of Virignia, 151 Engineer's Way, Charlottesville, VA, 22904, United States of America, mp3ua@virginia.edu

As automated trading has grown to make up over 70 percent of trade volume in most financial markets, the behavior of markets has changed. Trade volume has increased dramatically and the price formation process is ever evolving, as new algorithms enter the market and old ones leave. Using a Markov model to measure the relationship of trade between groups of participants we can further understand the dynamics of price formation and monitor for potential price anomalies, like flash crashes.

■ WA13

Level 2 - Room 202A

Disaster and Emergency Management: Models

Contributed Session

Chair: Janny Leung, The Chinese University of Hong Kong, Systems Engineering & Eng. Mgt. Dept., CUHK, Shatin, New Territories, Hong Kong, Hong Kong - PRC, janny@se.cuhk.edu.hk

1 - A Modeling Approach to Emergency Management
Brian Hunt, Assistant Professor of Mathematics, Johnson C. Smith University, 100 Beatties Ford Road, Charlotte, NC, 28216, United States of America, bjhunt@jcsu.edu, Paul Latham

We present a model of North Carolina Emergency Management's disaster logistics process for fulfilling disaster supply requests. The model will provide an advance planning tool to determine the optimum logistics process resources (request processors, supply purchasers, delivery trucks, etc.) required to meet performance objectives for delivery depending on predicted daily demand levels.

2 - Social Media and Allocating for Disaster Response
Christie Nelson, Rutgers University, 23A Norwood Ct, Princeton, NJ, 08540, United States of America, christie.l.nelson.phd@gmail.com, William M. Pottenger

Loss from weather-related disasters from 1980-2011 was $1060 billion in 2011USD and 30,000 people lost their lives in North America. Gathering information from emergency text messages to respond quickly with life-saving efforts is important. This research developed a methodology to summarize text messages sent during a disaster for responders, including analysis of geolocations to identify population areas in need. Disaster needs were then input into a resource allocation model for distribution.

3 - From Preparedness to Recovery: A Tri-level Programming Model for Disaster Relief Planning
Janny Leung, The Chinese University of Hong Kong, Systems Engineering & Eng. Mgt. Dept., CUHK, Shatin, New Territories, Hong Kong, Hong Kong - PRC, janny@se.cuhk.edu.hk, Takashi Irohara, Yong Hong Kuo

We propose a tri-level programming model for disaster preparedness planning. The three levels consider respectively, facility location and inventory pre-positioning, disaster damage, and response and recovery. Using an interdiction (vs. a stochastic) framework allows parametric and scenario analysis on damage severity, and facilitates scenario exploration for decision-support. We develop an iterative dual-ascent solution approach, present computational results and draw some managerial insights.

■ WA14

Level 2 - Room 202B

Supply Chain: Risk Managment

Contributed Session

Chair: Changrong Deng, Duke University, Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, changrong.deng@duke.edu

1 - Applying the Incentive Theory Sourcing Model with Credit Guarantee Mechanism
Cheng-Feng Wu, doctoral student, National Taiwan University, Floor 9, No.1, Sec. 4, Roosevelt Road, Taipei, Taiwan - ROC, d99741006@ntu.edu.tw, David Ming-Huan Chiang

The strait of capital shortage in SMEs causes them difficult to fulfill orders, resulting in poor performance of the supply chain. Therefore, obtaining and operating financial support for SMEs is a significant issue. This study tries to develop the model to examine the issue of incentive theory sourcing model with trade guarantee mechanism from manufacturer's perspectives. In addition, we perform sensitivity analysis on selling price, default rate and fulfill rate.

2 - Dual Sourcing Model with Supply Disruption Risks
Chia Ping Lin, Ph.D. Candidate, National Taiwan University, College of Management Floor 9, No.1, Sec. 4, Roosevelt Road, Taipei Taiwan, Taipei, Taiwan - ROC, d95741004@ntu.edu.tw, David Ming-Huan Chiang, Mu-Chen Chen

Global sourcing is applied commonly in nowadays supply chain practice. The contract manufacturers take order from brand manufacturers and outsource the manufacturing activities to suppliers. Due to the contract manufacturer has the higher effect in the sourcing relationship, this paper formulates how to allocate order quantities of two suppliers with disruption risks as a Stackelberg game. In the model, a contract manufacturer is leader as well as two suppliers are followers.

3 - Single vs. Multiple Sourcing: Drivers of Supplier Diversification
Changrong Deng, Duke University, Fuqua School of Business, 100 Fuqua Drive, Box 90120, Durham, NC, 27708-0120, United States of America, changrong.deng@duke.edu, Fernando Bernstein, Sasa Pekec

A manufacturer's optimal decision to diversify orders across multiple suppliers might not only be due to supply risk management, but it could also result from the shape of the manufacturer's revenue function or the suppliers' production functions. Specifically, some forms of supply risk (random yield) cannot be mitigated by diversification.

■ WA15

Level 2 - Room 203

Designing and Managing Service Systems

Sponsor: Service Science

Sponsored Session

Chair: Roland Rust, Distinguished University Professor, U.niversity of Maryland, Smith School of Business, College Park, MD, 20742, United States of America, rrust@rhsmith.umd.edu

1 - Strategic Learning by e-Service Suppliers in Service Value Networks
Steven Kimbrough, U. of Pennsylvania, The Wharton School, 3730 Walnut Street, Philadelphia, PA, 19104, United States of America, kimbrough@wharton.upenn.edu, Christian Haas, Clemens van Dinther

We examine strategic behavior of e-Service suppliers that offer electronic services in complex Service Value Networks (SVNs). We study two specific learning regimes (a genetic algorithm and the Probe and Adjust learning algorithm) that can handle the associated complex strategy space. Our results show that even with relatively simple learning regimes, e-Service suppliers are able to find beneficial offers and learn to collude tacitly (and presumably legally), which increases their profits.

2 - IT Capability for Health Care Delivery: Is More Better?
Kingshuk Sinha, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Sriram Thirumalai, Asoke Dey

Electronic medical record (EMR) capability is the ability to leverage health IT to enable and link the clinical processes for an effective and efficient delivery of care. Findings of an empirical study will be reported that investigated (i) the performance implications of EMR capability and (ii) whether providers should commit to higher stages of EMR capability.

3 - An Analytical Tool for Characterization of Productivity and Quality Issues in IT Services
Victor Cavalcante, IBM Research, Rod. Jornalista F. Aguirre Proença, km 09 (SP101) Chacaras Assay, Hortol,ndia, SP, 13186-900, Brazil, victorfc@br.ibm.com, Rogério Paula, Carolina Andrade, Claudio Pinhanez, Cleidson de Souza, Ana Appel

This work describes an analytical tool to evaluate the performance and quality of incident management (IM) systems in IT service factories. Based on the normalization of ticket assignment delay and resolution time by their respective service-level agreement, the method computes and plots the spreading of ticket data on a log-log chart. By comparing the actual and desired distribution values in specific areas, the method diagnoses specific problems and issues in the performance of IM systems.

4 - Return on Service Amenities
Roland Rust, Distinguished University Professor, U. of Maryland, Smith School of Business, College Park, MD, 20742, United States of America, rrust@rhsmith.umd.edu, Rebecca Hamilton, Michel Wedel, Chekitan Dev

We build a model of how service amenities produce financial return. We apply the model in the context of hotel amenities, using a large-scale customer database provided by a major hotel chain, and employ hierarchical Bayesian estimation to estimate the model. The estimation results are then used to evaluate return on investment for two service amenities, for each of several hotel brands.

■ WA16

Level 2 - Room 204

Healthcare Systems Operations and Management

Sponsor: Health Applications

Sponsored Session

Chair: Eduardo Perez, Assistant Professor, Texas State University, 601 University Drive, San Marcos, TX, 78666, United States of America, eduardopr@txstate.edu

1 - A Simulation-optimization Approach for Scheduling Outpatient Chemotherapy Appointments
Michelle Alvarado, Ph.D. Student, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, alvarado.michelle.m@gmail.com, Tanisha Cotton, Lewis Ntaimo

We develop a simulation-optimization methodology for scheduling chemotherapy appointments with uncertain appointment lengths, acuity levels, and resource availability. We formulate a stochastic integer programming (SIP) model to schedule resources for a patient's treatment regimen. A simulation model emulates the oncology clinic operations and uses the performance measures to update the SIP model decisions. The proposed methodology is evaluated using patient data from a Texas oncology clinic.

2 - Generating Better Inpatient Dialysis Schedules
Ruben A. Proano, Assistant Professor, Rochester Institute of Technology, Rochester Institute of Technology, Rochester, NY, 14623, United States of America, rpmeie@rit.edu, Michael Kuhl, Manuel Tolentino

Scheduling dialysis procedures for inpatients is a complex process that requires determining when a patient should receive treatment, while considering a limited number of dialysis units, isolation requirements, and other more critical medical procedures already scheduled for the patient. This study proposes an optimization approach to minimizes tardiness associated with scheduling dialysis procedures.

3 - An Optimization Model to Improve Resource Utilization in a Cancer Clinic
Anali Huggins, Montana State University, 220 Roberts Hall, Bozeman, MT, 59717, United States of America, anali.huggins@msu.montana.edu, David Claudio

The objective of this research is to improve resource utilization at an outpatient Cancer Clinic. An optimization model was developed to maximize infusion chair utilization. The model takes into consideration the balance of human resource workload. This yields a more realistic model that takes into account constraints in physical and mental demand.

4 - Appointment Scheduling for a Server with Sequence-dependent Deteriorating Effects
Eduardo Perez, Assistant Professor, Texas State University, 601 University Drive, San Marcos, TX, 78666, United States of America, eduardopr@txstate.edu

We describe a mixed integer programming model for scheduling jobs on a single-server with deteriorating effects. The deterioration (fatigue) of the server and the job processing times are functions of the sequence of jobs that have been processed by the server. We focus on the simultaneous effects of sequencing jobs and scheduling start times by considering the overtime cost. We create a set of test problems and provide a computational procedure that evaluates the optimal job schedules.

■ WA17

Level 2 - Room 205A

Service Contract

Sponsor: Service Science

Sponsored Session

Chair: Amit Mitra, Professor, Auburn University, College of Business, 419 Lowder Hall, Auburn, AL, 36849-5266, United States of America, mitraam@auburn.edu

1 - Design and Pricing of Derivative Contracts in a Spectrum Market
Aparna Gupta, Rensselaer Polytechnic Institute, 110 Eight Street, Troy, NY, United States of America, guptaa@rpi.edu, Koushik Kar, Praveen Kumar

We design and price derivative contracts on spectrum for managing risks caused by uncertainties in spot prices of spectrum licenses. A secondary spectrum market allows wireless providers to purchase spectrum access licenses of short duration using spot contracts and derivative contracts on spectrum. A spot contract provides immediate access, while derivative contracts involve purchase of spectrum licenses in the future for predefined terms, thus playing important role in risk management.

2 - Coordinating Contracts in Value-based Healthcare Delivery
Tannaz Mahootchi, PhD Candidate, Wilfrid Laurier University, 75 University Ave. West, Waterloo, ON, N2L3C5, Canada, tmahootchi@wlu.ca, Logan McLeod, Ignacio Castillo

Value-based healthcare delivery requires reforms to different components of the healthcare system including organizational structure, outcome/cost measurement, and provider reimbursement. This study looks at coordinating contracts between healthcare purchasers and healthcare providers in this context. A dynamic principal-agent model is used to model the interactions between treatment strategy and health outcomes, where there is a single responsible entity for the health outcomes of the patient.

3 - Optimal Premium for Service Contracts
Amit Mitra, Professor, Auburn University, College of Business, 419 Lowder Hall, Auburn, AL, 36849-5266, United States of America, mitraam@auburn.edu

Product manufacturing/assembly often takes place in multiple locations requiring service organizations to deliver raw materials, sub-assemblies, or assemblies from one location to another. Customers may purchase damage protection contracts based on product value. Here, we investigate the amount of premium to be charged for such contracts.

■ WA18

Level 2 - Room 205B

Advances in Queueing Models I

Contributed Session

Chair: Yifan Feng, University of Minnesota, 127 Vincent Hall, 206 Church St. SE, Minneapolis, MN, 55455, United States of America, fengx233@umn.edu

1 - Analysis of an M/G/1 Batch Arrival Queue Subject to Disasters and Server Failures under N- policy
George Mytalas, Athens University of Economics and Business, Patision 78, 10434, Athens, Greece, mytalas@aueb.gr

We consider a M/G/1 queueing system with batch arrivals subject to disasters and server breakdowns under N-policy. The server is turned off as soon as the system empties until queue length reaches or exceeds a threshold. When a disaster occurs the system is cleared of all customers and the server initiates a repair period. During the repair period arriving batches of customers accumulate in the queue without receiving service. Besides, the server has an exponential lifetime.

2 - Analysis and Approximation of Tandem Queues with Finite Buffer Capacity
Kan Wu, Assistant Professor, Nanyang Technological University, 50 Nanyang Ave., School of MAE, Singapore, 639798, Singapore, kan626@gmail.com, Ning Zhao

Tandem queues with finite buffer capacity are commonly existed in practical applications. By viewing a tandem queue as an integrated system, a novel approach has been developed to analyze the queue time through the insight from Friedman's reduction method. We show that the capacity of a tandem queue with finite buffers diminishes, and its service rates depend on the arrival rates in general. Approximate models have been developed through the concept of virtual interruptions in the BSIA system.

3 - Workload Invariance in Multi-Server Systems

Muhammad El-Taha, Professor, University of Southern Maine, Department of Mathematics and Statistics, 96 Falmouth St., Portland, ME, 04104, United States of America, eltaha@usm.maine.edu

In multi-server systems, invariance of workload is a key step in establishing conservation and strong conservation laws. We give examples of systems where workload is not invariant in a sample path sense. However, we show that invariance in a sample path sense holds for a modified system. This result is then used to show the invariance property holds in a stochastic sense under weak conditions for the standard multi-server system.

4 - Matsui's Form "W=ZL": A Knowledge of Little's, Matsui's and EOQ Formula

Masayuki Matsui, Professor, Kanagawa University, 3-27-1 Rokkakubashi, Kanagawa-ku, Yokohama, 221-8686, Japan, matsui@kanagawa-u.ac.jp

This paper presents a class of discrete intelligence form: W(Q)=Z(Q)L(Q), an extended form of Little's formula and Matsui's equation(1977)to the world of lot-size version (EOQ formula). This result would hold on lot-size (EOQ) type for Q <-> 1/Z, and EOQ would regretably give the maximization of W (producer's risk) whe it is economic. Thus, it would be also noted that Little's formula may be originated in EOQ formula since 1913, and this may give the 100th anniversary evidence since Ohm's law.

5 - Optimal Partition Strategy for Multi-Class Queuing Systems

Yifan Feng, University of Minnesota, 127 Vincent Hall, 206 Church St. SE, Minneapolis, MN, 55455, United States of America, fengx233@umn.edu, Zizhuo Wang

We study the issues of how to partition arriving customers into service groups with appropriate service rates in a multi-class queueing system. The goal is to minimize the total expected waiting times. The tradeoff of partitioning lies in the pooling effect and the blocking effect of the slow type customers. When the service time difference is large, we find partition is better. We identify structures of the optimal partition strategy and propose efficient method to find the optimal partition.

■ WA19

Level 2 - Room 205C

Matching Markets I

Sponsor: Applied Probability

Sponsored Session

Chair: Yashodhan Kanoria, Assistant Professor, Columbia University, Columbia Graduate School of Business, Uris Hall, 3022 Broadway, New York, NY, 10027, United States of America, ykanoria@columbia.edu

1 - Improving Community Cohesion in School Choice via Correlated-lottery Implementation

Peng Shi, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-149, Cambridge, MA, 02139, United States of America, pengshi@mit.edu, Itai Ashlagi

In many cities, students apply to public schools by submitting a ranked list of schools to a centralized lottery. One criticism is that kids from the same community are scattered across the city. We study how much one can improve community cohesion by correlating the lottery for students from the same community. We derive analytical expressions under a large market approximation, and show that gain is greater when preferences are more correlated. We show promising simulation results for Boston.

2 - How to Control Controlled School Choice

Federico Echenique, Professor, California Institute of Technology, 1200 E California Blvd, Pasadena, CA, United States of America, fede@hss.caltech.edu, Bumin Yenmez

We characterize choice rules for schools that regard students as substitutes while at the same time expressing preferences for a diverse student body. The stable (or fair) assignment of students to schools requires the latter to regard the former as substitutes. Such a requirement is in conflict with the reality of schools' preferences for diversity. We show that the conflict can be useful, in the sense that certain unique rules emerge from imposing both considerations.

3 - Tuition Exchange

Utku Unver, Professor of Economics, Boston College, Boston, MA, United States of America, unver@bc.edu, Umut Dur

We introduce a new matching model to mimic inter-college tuition exchange programs for dependents of faculty to attend other colleges tuition-free. Programs use decentralized markets making it difficult to achieve balance. We show that stable equilibria discourage net-exporting colleges from exchange. We introduce two-sided top-trading-cycles as the unique mechanism that is balanced-efficient, student-strategy-proof, and respecting priority bylaws regarding dependent eligibility.

4 - An Optimal Randomized Mechanism for the 2-Agent Kidney Exchange Problem

Tulia Herrera, PhD Candidate, Columbia University, 500 W. 120th St., Mudd 313, New York, NY, 10027, United States of America, tjh2128@columbia.edu, Jay Sethuraman

We consider matching problems arising in kidney exchanges between hospitals. Focusing on the case of two hospitals, we construct a randomized strategy-proof mechanism that is guaranteed to return a matching that is at least 3/4 the size of a max-cardinality matching, thus answering an open question of Caragiannis et al. It is known that no better performance is possible among mechanisms that return a maximal matching, and so our mechanism is best possible within this class of mechanisms.

■ WA20

Level 2 - Room 205D

Pricing in Supply Chains

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ming Chen, California State University-Long Beach, 1250 Bellflower Boulevard, CBA 313, Long Beach, CA, 90840, United States of America, Ming.Chen@csulb.edu

1 - Recent Developments of Dynamic Pricing Research in Revenue Management

Ming Chen, California State University-Long Beach, 1250 Bellflower Boulevard, CBA 313, Long Beach, CA, 90840, United States of America, Ming.Chen@csulb.edu, Zhi-Long Chen

In the last fifteen years, numerous success stories of dynamic pricing applications have motivated a rapidly growing research interest in a variety of dynamic pricing problems. In this paper, we present a survey of recent developments of dynamic pricing models in revenue management and identify several interesting research areas.

2 - Comparative Analysis of Markup, Markdown and Mixed Pricing Policies in Revenue Management Problems

Wei Guo, University of Minnesota, Twin Cities, 111 Church Street, Minneapolis, MN, 55414, United States of America, guo@aem.umn.edu, Zizhuo Wang

We compare the expected revenue generated from three pricing policies for a finite horizon revenue management problem: markup only, markdown only and mixed. We study the optimal solutions for each policy and show that the markdown policy is superior to the markup policy when inventory level is low and the remaining time is long; otherwise the markup policy is superior. And the gap between both of the policies to the mixed pricing policy is small. We verify our findings through numerical tests.

3 - Demand Allocation Effects of Product-line Pricing with Advance Selling

Mingyu (Max) Joo, Assistant Professor, The Ohio State University, 2100 Neil Ave., Columbus, OH, 43210, United States of America, joo.85@osu.edu, Ken Wilbur, Dinesh Gauri

Firms use product line pricing to manage demand not only across products but also across time periods. To understand the intertemporal effects, this paper estimates a nested logit model in the cruise industry based on descriptive analyses. The results show that the firm is able to use product line pricing to allocate demand across time periods. A policy experiment shows that intertemporal price variation accounts for 18% of revenues relative to optimal product line pricing alone.

4 - Dynamic Pricing and Inventory Management under Fluctuating Procurement Costs

Renyu Zhang, WashU, Business School, Campus Box 1133, One Brookings Drive, St. Louis, MO, 63130, United States of America, renyu.zhang@wustl.edu, Nan Yang, Guang Xiao

We consider a periodic review joint pricing and inventory control model in which the firm orders from a spot market with fluctuating procurement costs to meet price-dependent stochastic demand. We show that a cost-dependent order-up-to/pre-order-up-to/list-price policy is optimal. We offer the unique insight on the risk-seeking attitude of a risk-neutral firm and show that dual-sourcing and dynamic-pricing are strategically complementary in the presence of procurement cost fluctuating.

■ WA21

Level 2 - Room 206

Healthcare Innovations

Sponsor: Health Applications

Sponsored Session

Chair: Diwakar Gupta, Professor, University of Minnesota, 130B Mechanical Engineering, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, guptad@me.umn.edu

1 - Implications of a Population Health Focus on Clinic Metrics and Models

Sandra Potthoff, Professor, University of Minnesota, Minneapolis, MN, United States of America, potth001@emn.edu, Diwakar Gupta

Medical homes and service line management are strategies that healthcare systems are implementing as care moves to the clinic setting. These changes are driven by reimbursement models with a population health focus. As clinic managers face these changes, they need metrics that assess case mix adjusted total cost of care across the healthcare supply chain. We review current clinic level metrics/models, and discuss new ones to consider given reimbursement and clinic operational changes.

2 - The Bundled Payments Care Improvement Initiative of the CMS: A Normative Analysis

Mili Mehrotra, Assistant Professor, The University of Minnesota, 321 19th Ave. south, #321, Minneapolis, MN, 55406, United States of America, milim@umn.edu, Diwakar Gupta

CMS has introduced the Bundled Payments for Care Improvement Initiative. The initiative is a method of combining payment for all service providers involved in an episode of care to a single payment. This initiative encourages care coordination and removes financial incentives of providers to increase volume without improving quality of care under the fee-for-service payments. We analyze the efficacy of this initiative in achieving the CMS' goal to maximize the welfare of medicare enrollees.

3 - Fee-for-Service Contract in the Pharmaceutical Supply Chains

Hui Zhao, Smeal College of Business, Penn State University, University Park, United States of America, huz10@psu.edu, Chuanhui Xiong, Srinagesh Gavirneni, Adam Fein

Pharmaceutical industry takes an important role in healthcare but has received relatively less attention from supply chain researchers. In this talk, we will provide an overview of the pharma supply chain with an analysis of the Fee-for-service (FFS) contracts which dramatically changed the way pharma distribution supply chains are designed, managed, and operated. Our results address a few challenges faced by pharma manufacturers and distributors.

4 - Physician Panel Design

Wen-Ya Wang, San Jose State University, One Washington Square, San Jose, CA, United States of America, wenya.wang@sjsu.edu, Diwakar Gupta

This paper focuses on the physician panel design problem of determining the patient composition (i.e. panel size and types of patient) for physician panels. We investigate how clinics would allocate a given pool of two types of patients who have different propensity for requesting urgent appointments to two identical physicians. We identify the optimal patient and capacity allocation strategies that maximize the clinic's overall expected reward under different capacity-demand scenarios.

■ WA22

Level 2 - Room 207

Health Care II: Data Analysis

Contributed Session

Chair: Mahtab Jahanbani Fard, Wayne State University, Manufacturing Engineering Building, 4815 Fourth St., Detroit, MI, 48202, United States of America, es2330@wayne.edu

1 - A Model for Forecasting Binary Outcomes Resulting from Human Behavior

Shannon Harris, University of Pittsburgh, Katz Graduate School of Business, Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu, Jerrold May

We consider forecasting the next outcome of a binary human behavior process, based only on its historical values. Our model has three components that capture critical aspects of the underlying behavioral process. We illustrate our approach using data from patients' attendance and non-attendance at VA outpatient clinics.

2 - Tracking and Tracing of Hospital Acquired Diseases by Coupled Hidden Markov Models

Ziye Zhou, The Chinese University of Hong Kong, Room 514, William M W Mong Eng. Bldg., CUHK, Hong Kong, Hong Kong - PRC, zhouzy@se.cuhk.edu.hk, Chun-Hung Cheng, Dorbin Tobun Ng

An approach combining the ideas of network epidemiology and coupled hidden Markov models is developed to study tracking and tracing of hospital acquired diseases. This approach encapsulates network structure, infection dynamics and individual's disease history under a unified framework.

3 - Defining Episodes of Care from Rich Data

Seyedmohammad Emami, Graduate Research Assistant, Rochester Institute of Technology, 10-6 Colony Manor Dr., Rochester, NY, 14623, United States of America, sme3279@rit.edu, Ruben A. Proano

We develop a clustering based algorithm to determine episodes-of-care for medical treatments in order to evaluate the implementation of a community-wide bundled payment reimbursement system. Our methodology automatically determines the set of services that constitute an episode of care for different diagnoses and patient cohorts.

4 - Optimal Medication Mix for Poly-Pharmacy Patients

Abdolmanaf Zargoush, ESSEC Business School, Avenue Bernard Hirsch, Cergy-Pontoise, France, b00114510@essec.edu

We use 5 years of data for 19,223 diabetic patients to learn a causal network of interactions among diabetes medications, demographic variables, comorbidities, severity measures and survival. On the basis of a heuristic method, then, we show how a statistically derived Bayesian network can be used to optimally recommend the combination of medications for poly-pharmacy patients.

5 - Electronic Medical Record Data Analysis using Hidden Markov Model

Mahtab Jahanbani Fard, Wayne State University, Manufacturing Engineering Building, 4815 Fourth St., Detroit, MI, 48202, United States of America, es2330@wayne.edu, R. Darin Ellis

In this study we model physician usage of electronic medical record (EMR) and predict eye gazing to patient during visit. We use Hidden Markov Model to predict the eye gazing sequence during visit using EMR. Also research shows that there are associations between physician's EMR patterns and patient satisfaction. So predicting eye gazing during physician-patient visit will help us to find a metric to measure patient satisfaction.

■ WA23

Level 2 - Room 208A

Pricing under Retail Competition with Multiple Products

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Candace Yano, Professor, UC Berkeley, IEOR Dept. and Haas School of Bus., Berkeley, CA, 94720, United States of America, yano@ieor.berkeley.edu

1 - Supply Chains in the Presence of Store Brands

Xiang Fang, Assistant Professor, University of Wisconsin—Milwaukee, Lubar School of Business, Milwaukee, WI, 53201, United States of America, fangx@uwm.edu, Vithala Rao, Srinagesh Gavirneni

We analyze a supply chain in which a retailer accepts (with the appropriate contractual agreements) a national brand for resale and then determines whether to introduce a store brand, how to price the store brand, and what quantities of the product(s) to order. We find that the efficiency loss in the decentralized supply chain becomes smaller when a store brand is introduced.

2 - Product (Mis)Fit Information and Strategic Channel Decisions in Store Brand Context

Arcan Nalca, Queen's School of Business, Queen's University, Kingston, ON, Canada, arcan.nalca@business.queensu.ca, Tamer Boyaci, Saibal Ray

We study the dynamics of national brand and store brand introductions, and its implications on the trading decisions involving prices and orders within a manufacturer-retailer channel. In our setting, a new national brand product is launched when there is still ex-ante uncertainty about consumer tastes, and the retailer learns about the desired product characteristics while selling this product. We investigate the optimal retail strategy to capitalize on this temporarily distinct information.

3 - Store Brand Positioning in the Presence of Retail Competition
Bo Liao, PhD Candidate, Haas School of Business, UC Berkeley, Haas School of Business, UC Berkeley, Berkeley, CA, 94720, United States of America, bo_liao@haas.berkeley.edu, Candace Yano

We characterize a retailer's equilibrium store-brand quality level when competing with another retailer also offering a store brand; both retailers carry the same national brand. All parties choose their respective prices. We find the retailer's key tradeoff is between product differentiation and bargaining power vis-‡-vis the national brand manufacturer.

4 - An Empirical Analysis of Product Category Entry Decisions
Necati Tereyagoglu, Assistant Professor, Georgia Institute of Technology, Scheller College of Business, Atlanta, GA, United States of America, Necati.Tereyagoglu@scheller.gatech.edu, Cem Ozturk

Using a comprehensive store-level data set, we investigate retailer's strategic decisions regarding which product categories to offer. In particular, we investigate how category entry decisions are related to company, customer and competition characteristics.

■ WA24

Level 2 - Room 208B

Demand Control Strategies (Planning and Pricing) in Revenue Management II

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: So Yeon Chun, Assistant Professor, Georgetown University, Mcdonough School of Business, 37th and O Streets, N.W., Washington, DC, 20057, United States of America, sc1286@georgetown.edu

1 - Giving it Away to Increase Profits? Price Discrimination and the Effect of Free Goods
Jacob Chestnut, PhD Candidate, University of Michigan, 701 Tappan St. R0400, Ann Arbor, MI, 48109, United States of America, jacobpc@umich.edu, Hyun-Soo Ahn, Ravi Anupindi

We consider a provider serving customers who are heterogeneous in their willingness-to-pay and desired quality. A standard approach is to model as an adverse selection problem, which results in a non-linear pricing schedule. Motivated by empirical evidence that consumer's utility becomes discontinuous when the goods are offered for free, we examine situations where giving away for free can indeed increase the provider's profit.

2 - Transfer Pricing to Decentralized Dynamic Programming Agents
Dan Adelman, Professor of Operations Management, University of Chicago, Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, dan.adelman@chicagobooth.edu, Canan Uckun

We discuss a new approach to approximating the optimal value function of certain dynamic programs through internal transfer prices charged by a central authority to decentralized agents in a hierarchical structure. We show the structure of optimal prices and study a scalable numerical algorithm for computing them. We discuss applications in demand response for the electricity smart grid.

3 - Promotion Optimization with Multiple Vehicles
Georgia Perakis, Massachusetts Institute of Technology, Sloan School of Management, 100 Main Street, Cambridge, MA, United States of America, georgiap@mit.edu, Maxime Cohen, Zachary Leung

We study promotion optimization with multiple vehicles, i.e. which items to promote, at what prices and with which vehicle (e.g. flyer and display). We consider demand models that are easy to estimate from data and capture interesting consumer behavior. We propose and study a decomposition approach where price optimization and vehicle selection are solved sequentially. We study the solution of each sub-problem and validate our model through supermarket data.

4 - Crowdvoting the Timing of New Product Introduction
Rene Caldentey, New York University, Stern School of Business, 44 West Fourth Street, New York, United States of America, rcaldent@stern.nyu.edu, Victor Araman

We consider a seller who is considering introducing a new product into the marketplace. In order to improve demand forecasts, the seller uses an online voting system that allow potential buyers to comment on the product's attributes and their likelihood of purchase if the product is made available on the market. We study the design of such a voting system and the pricing of the product.

■ WA27

Level 2 - Room 209A

Inventory Management: Decision Support

Contributed Session

Chair: Jon Lowe, Clemson University, 110A Freeman Hall, Clemson, SC, 29634, United States of America, jjlowe@clemson.edu

1 - Mathematical Metrics for a Multi-stage Inventory Control Policy in Supply Chains
Milton Soto-Ferrari, Western Michigan University, 4601 Campus Drive, Kalamazoo, MI, 49008-5200, United States of America, miltonrene.sotoferrari@wmich.edu, Juan Escorcia, Diana Prieto

We develop a set of mathematical metrics to determine the parameters for a multi-stage inventory control policy in supply chains, evaluating cost and cycle service level in a continuous review system. We provide an inventory evaluation framework for the links considered in the network and a set of recommendations, in order to increase the coordination and the overall effective performance of a supply chain.

2 - Optimal Dynamic Order and Assembly Policy for a Stochastic Nested Inventory System
Lei Xie, Professor, Shanghai Jiao Tong University, Sino-U.S. Global Logistics Institute, Shanghai, China, linna.sky@gmail.com, Youyi Feng

We study a nested assemble-to-order (ATO) system under periodic review with multiple products. Stock of every component is replenished with a positive leadtime through a outside supplier. Product demands are random and fulfilled by assembling process instantaneously (within negligible leadtimes). Unsatisfied demand for any product is backlogged. We characterize relationships among backlogs of the products and stocks of the components on hand or in transit by a structural property.

3 - A Decision-theoretic Model for Hurricane Inventory Planning
Paul Cronin, University of Texas at Austin, CBA 5.334A, 2100 Speedway Stop B6500, Austin, TX, 78712, United States of America, paul.cronin@utexas.edu, John Butler, Douglas Morrice, Fehmi Tanrisever

As a hurricane nears the coast, consumers can choose to stock up. Inventory allocation is challenging for retailers in the region. We use an econometric model to estimate demand using actual purchase data and NOAA data from 2003-2008. A stochastic inventory model is used to investigate the optimal timing and level of inventory allocation. We develop insights into the relationships among holding costs, shortage costs, initial inventory, and the value of a two-stage allocation policy.

4 - Effective Resource Utilization in a Fixed Budget Allocation Inventory System
Jon Lowe, Clemson University, 110A Freeman Hall, Clemson, SC, 29634, United States of America, jjlowe@clemson.edu, Scott Mason

Classic inventory policy often focuses on reducing inventory levels to lower costs. We present a unique industrial case study wherein the company contractually must maintain a fixed dollar amount of inventory or else risk losing future fund allocations. As simply identifying inventory savings could cause a reduction in allocated budget, we developed a Monte Carlo simulator using three inventory policies to more effectively utilize the available budget.

5 - Pricing and Inventory Management during New Product Introduction when Shortage Creates Hype
Prashant Chintapalli, Doctoral Student, Indian Institute of Management, Bangalore, Bannerghatta Road, Bangalore, KA, 560076, India, prashant.ch@gmail.com

We analyse the combined pricing and inventory management during new product introduction when product shortage creates additional demand due to hype. We assume that while successful products exhibit hype, failed products do not exhibit any such phenomenon. We develop a two-period model in which a firm launches its product at the beginning of the first period and decides stocking level and selling price at the beginning of each period.

■ WA28

Level 2 - Room 209B

Applied Probability

Contributed Session

Chair: Golshid Baharian, University of Illinois at Urbana-Champaign, Industrial and Systems Eng Department, 201 N. Goodwin Ave., Urbana, IL, 61801, United States of America, gbahari2@illinois.edu

1 - Economics of the Tipping Point: Local Conformity, Global Diversity and Punctuated Equilibrium Effect

Nan Chen, Associate Professor, The Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk

In sociology, a tipping point refers to a point in time when a large number of group members rapidly and dramatically changes its behavior by widely adopting a previously rare practice. In this paper we propose a simple, analytically tractable, stochastic model to characterize this phenomenon in a rigorous way.

2 - The Limit of Stationary Distributions of Many-server Queues in the Halfin-Whitt Regime

Mohammadreza Aghajani, PhD Student, Brown University, 643 East Ave., Pawtucket, RI, 02860, United States of America, reza@brown.edu, Kavita Ramanan

We show that, for a general class of service distributions, the steady state queue lengths in a sequence of GI/GI/N queues in the Halfin-Whitt regime converges to (the marginal of) the unique stationary distribution of an infinite-dimensional Markov process. The proof of uniqueness of the stationary distribution uses an asymptotic coupling approach, which is likely to be of broader interest. This work is motivated by applications in call centers and data centers.

3 - Nursing Home Bed Planning Based on Medicaid Bed-hold Payment Policies

Jerome Niyirora, Binghamton University, 4400 Vestal Parkway East, Binghamton, NY, 13850, United States of America, jndayis1@binghamton.edu, William Massey, Otis Jennings

We approximate the number of beds needed to maximize profitability in a nursing home. Our analysis is based on a multi-server queueing model with abandonment, where the residual time to abandon equals its service time. This model accounts for the vacancy rate requirements and the probability of a resident being absent from the facility. Using a cost function based on certificate of need regulations, we optimize the number of beds over the transient behavior of the system.

4 - Limiting Behavior of the Stochastic Sequential Assignment Problem

Golshid Baharian, University of Illinois at Urbana-Champaign, Industrial and Systems Eng Department, 201 N. Goodwin Ave., Urbana, IL, 61801, United States of America, gbahari2@illinois.edu, Sheldon Jacobson

A class of problems is presented where available distinct resources are allocated to sequentially arriving tasks with stochastic parameters so as to maximize the expected reward per task, as the number of tasks approaches infinity. The problem is studied for (i) iid tasks with observable distributions and (ii) tasks with r distinct unobservable distributions governed by an ergodic Markov chain. Stationary optimal policies (along with convergence rates) are obtained for both problems.

5 - Prediction for User's Behavior Based on Stochastic Models

Jiayin Qi, Professor, Beijing University of Posts and Telecommunications, No.10, XiTuCheng Road, Haidian District, Beijing, 100876, China, qijiayin@bupt.edu.cn, Qixing Qu

With the development of Internet, paid video becomes future trend. Our study addresses the churn prediction of users paying video by constructing a stochastic model. The data come from video-on demand mode in Youku.com where the times of each user purchasing movie and terminating it are known. We compare the performance of our model with other models. The results show that our model performs better than the other model both at predicting user churn behaviour and in targeting valuable users.

■ WA29

Level 2 - Room 210A

Software Demonstration

Cluster: Software Demonstrations

Invited Session

1 - BizSimz - Flexible Educational Simulations

Chris Huston, Founder, BizSimz, 8 Sachem Circle, #5BizSimz, West Lebanon, NH, 03784, United States of America, chris.huston.t10@gmail.com

An overview of BizSimz simulations (FactorySim, CapacitySim, RmSim, FlexCap, SIP, BottleneckSim and QueueSim), discussing the options available for customizing the learning experience. See a demonstration of how to run the competitive simulations during a class session.

■ WA30

Level 2 - Room 210B

Heuristic Optimization Methodologies

Contributed Session

Chair: Siyang Gao, University of Wisconsin at Madison, 1513 University Ave., Room 3247, Madison, WI, 53706, United States of America, sgao5@wisc.edu

1 - A Constructive Heuristic for the Multi-zone Assembly Line Balancing with Physical Constraints

Bryan Pearce, Clemson University, Freeman Hall, Clemson, SC, 29634, United States of America, bpearce@clemson.edu, Mary Kurz

We investigate a multi-zone assembly line balancing problem with line-side inventory capacity constraints as well as a number of physical constraints. A balancing heuristic is presented that selects spatial boundaries between work zones, dynamically activating up to five parallel workers per station. To ensure availability of inventory staging space the rectangular packing feasibility problem is solved for intermediate line balance solutions.

2 - On-the-Fly Optimization: A List Heuristic for Finding a Minimum Vertex Cover

Amine Kamali, The University of Oklahoma, PO Box 2022, Norman, OK, 73070, United States of America, amine@ou.edu

The problem of finding a minimum vertex cover in a given graph is an NP-hard optimization problem. A list heuristic is developed and implemented in C. Its performance is assessed using an exact evaluation and an approximate evaluation. Applications to network design and computational biology are discussed.

3 - An Approximation Algorithm for the Stowage Stack Minimization with the Zero Re-handle Constraint

Ning Wang, City University of Hong Kong, Department of Management Sciences, Hong Kong, Hong Kong - PRC, wangning@cityu.edu.hk, Zizhen ZHANG, Andrew Lim

The zero rehandle problem aims to minimize the number of stacks accommodating all the containers in a multi-port shipment without occurring rehandles. We prove that the uncapacitated ZRP is equivalent to the circle graph and that the itinerary starting port doesn't affect the problem property. An approximation algorithm with a performance guarantee is proposed to construct solutions for the ZRP, both uncapacitated and capacitated. Moreover, a lower bound of ZRP is provided.

4 - Enhancing Nested Partitions Algorithm by Threshold Model

Siyang Gao, University of Wisconsin at Madison, 1513 University Ave., Room 3247, Madison, WI, 53706, United States of America, sgao5@wisc.edu

We propose to use threshold model (TM) to develop a new promising index for Nested Partitions (NP) algorithm, which is a partitioning and sampling based global search for large scale optimization. TM based NP framework is introduced and its global convergence is discussed. Numerical examples are presented to demonstrate the effectiveness of the proposed approach.

■ WA31

Level 2 - Room 211A

Computational Methods for Financial Engineering

Sponsor: Financial Services

Sponsored Session

Chair: Tim Leung, Assistant Professor, Columbia University, IEOR Department, 500 West 120th Street MC4704, New York, NY, 10027, United States of America, tl2497@columbia.edu

1 - Transform Methods in Financial Engineering

Liming Feng, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, fenglm@illinois.edu

Fourier transform based methods have become standard computational tools in financial engineering. They are particularly useful for derivatives valuation in models with known characteristic functions only. When the analyticity of the characteristic functions is utilized, Fourier methods become highly efficient with exponentially decaying approximation errors. We illustrate the effectiveness of Fourier methods with financial engineering examples, including the valuation of European, American and exotic options, and Monte Carlo simulation from analytic characteristic functions.

2 - Tutorial on Portfolio Optimization

John Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

Portfolio optimization is one of the oldest applications of OR. Despite its age, the topic still has substantial interest and opportunities for new research on the application and methods. This tutorial will provide an overview of work to date and possible future directions.

■ WA32

Level 2 - Room 211B

Entrepreneurship: Theory and Action

Sponsor: Technology Management

Sponsored Session

Chair: Sinan Erzurumlu, Babson College, 231 Forest St., Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Extending the Theory of Entrepreneurial Action to the Context of Disasters

Shu-Jung Sunny Yang, University of Essex, Essex Business School, Southend, United Kingdom, sunnyy@essex.ac.uk, Yanto Chandra, Yan Emma Liu

Disasters create recovery opportunities for potential economic, social and environmental value creation. Our model analysis shows in a supply chain that recovery strategies with higher degree of altruism generate higher recovery performance and less variation. Our work extends the theory of entrepreneurial action into the context of disaster.

2 - Leveraging Crowd-sourcing with Working Consumers

Meredith Shengli Hu, University of Southern California, 1194w 36th place, Los Angeles, United States of America, shenglih@usc.edu

An increasing number of firms, both multinational giants and start-ups are leveraging crowd-sourcing, the innovative strategy in marketing and operational decisions. We seek managerial insights by analyzing a game between firms and consumers in this context in terms of operational flexibility, demand forecasting and consumer valuation, and further empirically explore intriguing causality in a behavioral way in terms of pricing schemes.

■ WA34

Level 2 - Room 211D

Joint Session I-Sim/HS: Managing Healthcare Resources using Simulation

Sponsor: Simulation Society & Health Applications

Sponsored Session

Chair: Louis Luangkesorn, Research Assistant Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara St., Pittsburgh, PA, 15261, United States of America, lol11@pitt.edu

1 - Quantification of Surgical Team Communication Patterns Related to HRO Principles

Amanda Baty, Texas Tech University, Department of Industrial Engineering, Box 43061, Lubbock, TX, 79409, United States of America, amanda.baty@ttu.edu, Timothy Matis

This research establishes a set of high reliability organization (HRO) principles and recurrence metrics which are significant in predicting the performance of surgical teams based on their communication patterns, where performance is defined by the time to respond to a shock. Through a simulation study communication patterns of surgical procedures are analyzed. Linear regression is conducted to determine significant HRO and recurrence metrics in predicting performance of surgical teams.

2 - Applications of GIS, Mathematical and Simulation Models for Optimal Organ Allocation System

Naoru Koizumi, Assoc. Professor, George Mason University, 3351 N. Fairfax Dr, Arlington, VA, 22201, United States of America, nkoizumi@gmu.edu, Rajesh Ganesan, Amit Patel, Chun-Hung Chen, Monica Gentili, Nigel Waters, Keith Melancon, Debasree DasGupta, Dennis Nicholas, Divya Srinivasan

This study combined GIS, mathematical modeling and discrete event simulation to analyze geographic equity and efficiency of the US liver allocation system. The main objectives of the study were to: (i) identify key factors determining geographic disparity; (ii) identify optimal locations of existing and new liver transplant centers; (iii) identify new allocation boundaries, and (iv) test whether the mathematically produced liver allocation system can perform better than the actual system.

3 - Modeling, Analysis, and Redesign of Primary Care: A Simulation Approach

Xiang Zhong, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, xzhong4@wisc.edu, Sally Kraft, Elizabeth Strutz, Molly Williams, Jingshan Li

This work is dedicated to redesigning primary care at University of Wisconsin Health. A standard set of workflows that enable consistent and patient centered processes for the delivery system and provide a consistent clinical experience for patients would lead to improved outcomes. A discrete event simulation model is developed to analyze the patient flow in the primary care processes with complex interactions among patients, care providers, and resources.

4 - Evaluating a Proposed Discharge Unit using a Simulation Based on Clinical Length of Stay

Louis Luangkesorn, Research Assistant Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara St., Pittsburgh, PA, 15261, United States of America, lol11@pitt.edu, Mustafa Kilinc, Yasin Ulukus, Andrew Schaefer, Gilles Clermont

In an effort to reduce costs, many hospitals have reduced the numbers of available in-patient beds. One alternative policy for reducing congestion is to establish a discharge center which can more efficiently process standard discharge of in-patients and thereby free beds for use by other patients. We evaluate the usefulness of a discharge model through the adaptation of a patient flow simulation model of an entire hospital.

■ WA35

Level 2 - Room 212A

Theory of Network Optimization

Contributed Session

Chair: Vahidhossein Khiabani, TA/RA, North Dakota State University, Department of Industrial and Manufacturi, NDSU Dept. 2485, PO Box 6050, Fargo, ND, 58108-6050, United States of America, vahidhossein.khiabani@ndsu.edu

1 - New Insights in the Hub Location Problem Objective Function

Faisal Alkaabneh, Research Assistant, Masdar Institute for Science and Technology, Abu Dhabi, Masdar City, United Arab Emirates, falkaabneh@masdar.ac.ae, Ali Diabat

Hub location problem is a relatively new extension of classical facility location problems. Hubs are applied exploit the economies of scale due to large bundled commodities traveled between hubs on the inter-linked hubs.This advantage, however,creates another side effect,which is the congestion. Congested hubs jeopardize the performance of the entire network. This paper considers the effects of congestion together with nonlinear cost function that captures the scale of economies in the network.

2 - A Dynamic Programming Algorithm for a Web Service Composition Problem

Youngmin Ki, Master Student, POSTECH, Nam-Gu, KyungBuk, Pohang, Korea, POSTECH, San31, Hyoja-Dong, Pohang, 780-784, Korea, Republic of, trigun@postech.ac.kr, John Jung-Woon Yoo, Hyunchul Tae, Byung-In Kim

Web services located in different places can be integrated into a composite service. This talk shows that the web service composition problem with a non-function objective is identical to a conditioned shortest path problem (CSPP), in which a shortest path from a starting node to an end node is searched but a node can be visited only if the node's condition is satisfied. An efficient dynamic programming algorithm is developed for the problem.

3 - A Multi-commodity Interval-flow Network Approach to Solve Real World Problems

Ryan Cooper, Southern Methodist University, 4300 N. Central Expy, Suite 365, Dallas, TX, 75206, United States of America, ryan.cooper@orm-tech.com, Richard Barr

Presented is a multi-commodity extension to the interval-flow generalized network model. We detail its application through the use of a real-world production and procurement problem in both single period and multi-period configurations. Also shown is a fixed-charge model formulation which represents actual vendor setup fees for raw material procurement.

4 - Solution Approach for the Traveling Salesman Problem

George Kolomvos, Kathikas Institute of Research & Technology, Chatziarphanou 4, Kathikas, Paphos, 8573, Pafos, Cyprus, George.Kolomvos@gmail.com, George Liberopoulos, Mihalis Golias, Georgios K.D Saharidis

Our original problem is the VRP in a connected graph. In order to accelerate solution times, we reduce the problem focusing on the Euclidean symmetric TSP. We relax subtour elimination constraints and we add a special type of high-density cuts at each iteration using Benders decomposition and covering cut bundle (CCB) generation strategy. We compare our results against several formulations and we observe that for networks of some hundreds of nodes the CCB strategy is considerably faster.

5 - Reliability Based Joint Placement of Phasor and Flow Measurements for Observability of Power Network

Vahidhossein Khiabani, TA/RA, North Dakota State University, Department of Industrial and Manufacturi, NDSU Dept. 2485, P.O.Box 6050, Fargo, No, 58108-6050, United States of America, vahidhossein.khiabani@ndsu.edu, Amin Roudaki, Rasool Aghatehrani, Kambiz Farahmand

We proposed a reliability based joint optimal placement of phasor and flow measurements to resolve the conflicting objectives of minimum number of measurements installation cost-wise, and maximum level of system-wide reliability of observability. The model is solved for the IEEE standard test systems incorporating zero injection buses. The proposed model provides a much more economical solution compared to reliability based placement models in literature.

■ WA36

Level 2 - Room 212B

Health Care VII: Public Health, Quantitative Approaches

Contributed Session

Chair: Sandro Paz, University of South Florida, 4202 E Fowler Ave., Tampa, FL, 33620, United States of America, spaz@mail.usf.edu

1 - Decision Modeling for Management of Pregnancy in Obese Patients

Neil Desnoyers, Assistant Clinical Professor, Drexel University, Decision Sciences, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, ntd26@drexel.edu

Hahnemann University Hospital, has (since 2010), offered induction of labor at EDD (estimated date of delivery) for all gravidas with BMI >40 who don't have a contraindication to vaginal delivery. We know of no controlled trials specifically evaluating induction at 40 weeks versus 41 weeks among obese gravidas. We perform decision modeling to compare the impact of our practice to a comparable urban tertiary hospital which doesn't routinely induce prior to 41 weeks in similar patients.

2 - Dynamic Treatment and Chemoprophylaxis of Pandemic Influenza of Strains with Antiviral Resistant

Sandro Paz, University of South Florida, 4202 E Fowler Ave., Tampa, FL, 33620, United States of America, spaz@mail.usf.edu, Alex Savachkin

We use a large-scale simulation optimization framework to develop dynamic antiviral strategies including treatment of symptomatic cases and chemoprophylaxis of pre- and post-exposure cases. The model considers antiviral-sensitive and resistant strains with low/high fitness cost, induced by the use of the three antiviral measures. The mitigation strategies incorporate also non-pharmaceutical interventions and the analysis is conducted under different virus transmissibility and severity scenarios.

■ WA37

Level 2 - Room 213A

Planning and Scheduling Issues in Service and Manufacturing Systems

Cluster: Scheduling and Project Management, in Memory of Peter Brucker (1942-2013)

Invited Session

Chair: Chelliah Sriskandarajah, Professor, Texas A&M University, 320Q Wehner, 4217 TAMU, College Station, TX, 77843, United States of America, chelliah@mays.tamu.edu

1 - Managing Currency Supply in Mexico Banknote Supply Chain

Yunxia Zhu, Assistant Professor, Rider University, Sweigart Hall 358, 2083 Lawrenceville Road, Lawrenceville, NJ, 08648, United States of America, yuzhu@rider.edu, Subodha Kumar, Chelliah Sriskandarajah, Sara Rodrìguez Sanchez

This paper studies transportation and holding of banknotes of multiple denominations in Mexico Banknote Supply Chain. We first provide a MIP formulation for the Regional Bank's supply planning problem after proving that the First Fit Decreasing strategy can guarantee an optimal solution of the special bin-packing problem faced in this study. We also propose several polynomial-time algorithms for deriving either optimal or near-optimal solutions for the problem under different settings.

2 - A Decision Support Framework for Optimizing a Bank's Currency Network

Yiwei Huang, Texas A&M University, Mays Business School, 320R Wehner, 4217 TAMU, College Station, TX, United States of America, yhuang@mays.tamu.edu, Neil Geismar, Divakar Rajamani, Suresh Sethi, Chelliah Sriskandarajah, Marcelo Carlos

A Bank supplies currency to satisfy the demand of the financial institutions. The decisions to be made are selecting and prioritizing the locations of retail vaults that will be upgraded, selecting the most efficient transportation mode between branches and vaults, and optimizing the sourcing for the new currency network. The objective is to minimize the total cost including the upgrading cost, the transportation cost and the incremental capacity cost to select locations for new regional vaults.

3 - Scheduling Dual-Gripper Robotic Cells: Optimization over 1-Unit Cycles

Kyung Sung Jung, University of Texas-Dallas, Dallas, TX, United States of America, kxj083000@utdallas.edu, Neil Geismar, Michael Pinedo, Chelliah Sriskandarajah

We consider the problem of finding a cyclic sequence of robot moves that maximizes the throughput in dual-gripper bufferless robotic cells. The cell is designed to produce identical parts under the free-pickup criterion and the additive-travel-time metric in a circular layout. Obtaining an optimum 1-unit cyclic solution is the focus of this paper. We establish conditions where the problem of finding an optimal cycle is NP-hard. The remaining cases can be shown to be polynomial solvable.

4 - Prioritizing Regular Demand while Reserving Capacity for Emergency Demand

Ying Li, Clinical Assistant Professor, Texas A&M University, 4217 TAMU, College Station, United States of America, yli@mays.tamu.edu, Xinxin Hu

We formulate a finite-horizon, discrete-time, dynamic programming model in which a firm decides how to make reservation for emergency demand and how to prioritize two classes of regular demand. While emergency demand must be fulfilled within the period of arrival, regular demand can be backlogged. The optimal policy involves developing metrics that measure backlogging losses from various perspectives. We fully characterize the firm's optimal prioritization and reservation policy.

■ WA38

Level 2 - Room 213B

Topics in Supply Chain Management I

Contributed Session

Chair: Li Zhang, IBM Research - China, Building 19-A, Zhongguancun Software Par, Beijing, China, zhanglir@cn.ibm.com

1 - Transient Collaborations in Operation Networks

Adrian Tan, PhD Candidate, Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, N2L 3C5, Canada, tanx1410@mylaurier.ca, Hamid Noori

In this conceptual research, the transient process is introduced as a novel perspective to collaboration in networks. Propositions are offered to explain how the transient process creates sustained competitive advantages in fast-moving and unpredictable business environments. Our theoretical development is grounded in Resource-Based Theory and supply chain management literature.

2 - Complex Supply Chain Network Monitoring

Lei Liu, Arizona State University, 699 Mills Avenue, Tempe, AZ, 85282, United States of America, lliu58@asu.edu, Mani Janakiram, George Runger, David Bayba

Monitoring plays a key role for complex supply chain (CSC). We proposed a strategy of using multiple control charts to monitor a CSC that provides agile pinpoint when supply deviates. We monitor ship rate that is sensitive to small deviation and removes autocorrelation, design control charts being robust to non-normality yet sensitive to small change. To address the complexity, we developed control chart deployment strategies that provide detailed detection with low false alarm rate.

3 - A Real-time Route Selection and Recommendation System for Vehicle Logistics

Li Zhang, IBM Research - China, Building 19-A, Zhongguancun Software Par, Beijing, China, zhanglir@cn.ibm.com, Hongbo Li, Xin Shi, Shuang Ren, Hong Wei Ding

While a number of technologies have been developed to identify the "optimal" route for supply chain network, improvement is still needed regarding real-time implementation. Given a specific distribution network, we have developed a real-time route selection and recommendation method considering various kinds of business rules for vehicle logistics companies. Our method is easy to integrate with the existing enterprise level systems (such as ERP) for better control of total transportation cost.

■ WA41

Level 1 -101A

Empirical Research in OM/Marketing Interface

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Marcelo Olivares, Columbia Business School/ Universidad de Chile, Republica 701, Santiago, Chile, mo2338@columbia.edu

1 - A Model for Estimating Systematic Risk in Supply Chains

Vishal Gaur, Professor of Operations Management, Johnson School, Cornell University, 321 Sage Hall, Ithaca, NY, 14853, United States of America, vg77@cornell.edu, Nikolay Osadchiy, Sridhar Seshadri

The demand uncertainty faced by a firm can be caused by idiosyncratic factors or systematic economic factors. We investigate how systematic risk propagates through supply chain networks using industry-level data for the manufacturing, wholesale trade, and retail trade sectors of the U.S. economy. Our results have implications for the relative value of operational and financial hedging strategies used by firms.

2 - Empirical Analysis of a Buy-online, Pickup-in-Store Implementation

Antonio Moreno-Garcia, Kellogg School of Management. Northwestern University, Evanston, IL a-morenogarcia@kellogg.northwestern.edu, Santiago Gallino

Increasingly, retailers are integrating their offline and online channels to reduce costs or to improve the value proposition they make to their customers. Using a proprietary dataset, we analyze the impact of the implementation of a buy-online-pickup-in-store project.

3 - Stockpiling vs. Mental Budgets: The Case of the Retail Gasoline Industry

Margaret Aksoy-Pierson, Assistant Professor, Tuck School of Business at Dartmouth, 100 Tuck Hall, Hanover, NH, 03766, United States of America, mpierson@dartmouth.edu

Although consumers vary the volume of gasoline they purchase at each trip to the pump, they stick to a single spend target, regardless of price changes. This paper explores the moderating effect of mental budgeting on stockpiling behavior using transaction level data from 8 locations over 2 years of observation.

4 - Using Video Analytics to Measure the Value of Retail Salesforce

Marcelo Olivares, Columbia Business School/ Universidad de Chile, Republica 701, Santiago, Chile, mo2338@columbia.edu, Andres Musalem

We use video data collected at retail stores to assess the value of sale employees in engaging customers. We develop several econometric models that use different types of video data, which differ in the frequency of samples collected and the amount of information of the customer's shopping experience. We use these models to quantify the economic value provided by sales employees and thereby support staffing decisions.

■ WA42

Level 1 -101B

Empirical Research in Healthcare

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Nicos Savva, London Business School, Regent's Park, London, United Kingdom, nsavva@london.edu

1 - The Effect of Focus Across the Service Portfolio of Acute Hospitals

Stefan Scholtes, Professor, University of Cambridge, Trumpington Street, Cambridge, United Kingdom, s.scholtes@jbs.cam.ac.uk, Sandra Sülz, Ludwig Kuntz

Acute hospitals are legally obliged to provide services across a spectrum of acute conditions. In contrast to manufacturing firms, they cannot narrow this portfolio when they decide to focus on specific services. This raises the question whether non-focus services suffer when hospitals focus on some services or whether certain types of focus services can "pull up" non-focus services as well? We investigate these questions empirically with a multi-hospital dataset from Germany.

2 - Impact of Waiting Time on Patient Flow: An Econometric Analysis of Outpatient Clinics

Diwas KC, Emory University, 1300 Clifton Road, Atlanta, GA, 30322, United States of America, diwas.kc@emory.edu

We examine patient throughput at an outpatient clinic. We develop a non-parametric model of patient choice and find that capacity affects throughput in two ways - by reducing the likelihood that the patient books an appointment, and by reducing the likelihood that a scheduled patient shows up for an appointment.

3 - National Drug Stock-out Risks in Africa: The Global Fund Disbursement Process for Procurement

Iva Rashkova, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, irashkova.phd2009@london.edu, Jérémie Gallien, Prashant Yadav, Rifat Atun

We use historical data to construct and validate distributional forecasts of procurement lead times and disbursement inter-arrival times for Global Fund grants in 53 African countries. We use a validated simulation model to predict impact of these processes on central stock availability of a single product facing constant demand. We find that adjusting disbursement amounts to reflect historical disbursement schedules mitigates the risk of stockouts better than bridge financing or a buffer stock.

■ WA43

Level 1 -101C

Advances in Behavioral Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Srikanth Jagabathula, Professor, NYU Stern School of Business, 44 West Fourth Street, KMC Suite 8-74, new york, NY, 10012, United States of America, sjagabat@stern.nyu.edu

Co-Chair: Gustavo Vulcano, Associate Professor, Leonard N. Stern School of Business - NYU, 44 West Fourth St., Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu

1 - Strategic Diagnosis and Pricing in Expert Services

Senthil Veeraraghavan, University of Pennsylvania, Wharton School, 3730 Walnut Street, Philadelphia, PA, United States of America, senthilv@wharton.upenn.edu

Consumers often cannot identify solutions to problems on their own (for e.g. car repair), and rely on experts who also provide the service, for the diagnosis. The information asymmetry arising upon diagnosis leads to inefficiencies in service provision. The expert has an incentive to over-provide or to ration services, based on the demand, capacity and the consumer waiting costs. We investigate diagnosis and pricing decisions in expert service markets using a queuing framework.

2 - Honesty in Incomplete Supply Chain Contracts

He Chen, PhD Candidate, University of Maryland College Park, 3330C Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, hechen@rhsmith.umd.edu, Krishnan S Anand, Manu Goyal

Incomplete contracts are vulnerable to ex-post opportunistic behaviors. In an evolving (multi-period) relationship between a manufacturer and his supplier, we prove that an honest manufacturer can outperform an opportunistic manufacturer, even though the opportunistic manufacturer's strategy space includes mimicking the honest manufacturer. Thus, honesty emerges endogenously as the optimal policy.

3 - How to Manage a Category Captain - Trust and Trustworthiness in Information Sharing, Advice Provision

Upender Subramanian, Assistant Professor, The University of Texas at Dallas, Jindal School of Management, Richardson TX 75080, United States of America, upender@utdallas.edu, Ozalp Ozer, Yu WangYu

We study a retailer who relies on the market knowledge of a manufacturer designated as the "category captain". We examine channel performance and firms' profits under three arrangements: information sharing, advice provision and delegation. While standard theory predicts lack of cooperation, through laboratory experiments, we determine why and how each arrangement generates varying levels of cooperation by inducing different levels of trust and trustworthiness.

4 - Modeling Dynamic Choice Behavior of Customers

Srikanth Jagabathula, Professor, NYU Stern School of Business, 44 West Fourth Street, KMC Suite 8-74, new york, NY, 10012, United States of America, sjagabat@stern.nyu.edu, Gustavo Vulcano

Traditionally, operational models used for demand predictions model customers as making choices according to a known preference list. In practice, customers' preferences lists are not static and they change over time. We propose a dynamic model for how customers construct preference lists over time as a function of all products that were purchased and were on offer in the past. We show that this model allows us to explain several "behavioral" biases that have been empirically established.

■ WA44

Level 1 -101D

Supply Chain: Optimization I

Contributed Session

Chair: Zohar Strinka, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, zstrinka@umich.edu

1 - Integrated Distribution Planning with Delivery Deadlines and Service Level

Gang Wang, Assistant Professor, Kean University, 1000 Morris Avenue, EC-308, Union, NJ, 07083, United States of America, gwang@kean.edu

An integrated planning problem is studied with delivery deadlines and service level over a capacitated supply and distribution network. The problem is formulated as a bi-criteria mixed integer nonlinear program to achieve a trade-off between the total costs and the service level. In this paper, two classes of problems are taken into consideration in terms of service level constraint. Empirical observations are reported to demonstrate the effectiveness of the proposed algorithms.

2 - Integrated Optimization on Outsourcing and Production Decisions in Global Supply Chain

Lu Zhen, Professor, Shanghai University, Shangda Road 99, School of Management Building, 351 Room, Shanghai, 200444, China, lzhen.sh@gmail.com

Manufacturers in China are facing decisions on supplier adoption in overseas and domestic markets, production plans for customers in the two markets. These decisions are intertwined. This paper studies an integrated optimization problem on outsourcing and production decisions under environment of global supply chain and China's export-oriented tax policies. A three stage decision model is proposed. A cross entropy based solution method is also developed for solving the three stage model.

3 - Routing and Scheduling at a Cross-dock Warehouse

Rajesh Piplani, Assoc. Professor, Nanyang Tech. University, School of Mechanical and Aerospace Eng. Singapore, 639897, Singapore, mrpiplani@ntu.edu.sg, Dwi Augustina, Carman Lee

This research focuses on the integration of vehicle scheduling and routing (VRS) at a cross-doc warehouse, considering product consolidation and delivery time window constraints. The system is modeled as a mixed- integer program with the objective to minimize the system costs of food delivery. The model is then modified by introducing the idea of customer zones and applying hard time windows for delivery (VRSP-CZHTW).

4 - Approximation Algorithms for Selective Newsvendor Problems and Generalizations

Zohar Strinka, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, zstrinka@umich.edu, Edwin Romeijn

We study a supplier facing uncertain demands and revenues in a collection of markets. The supplier chooses markets and other decisions to minimize a risk measure of the cost function. Costs include lost revenues in deselected markets as well as logistics and newsvendor-type costs for the collection of selected markets. We develop high-probability constant-factor approximation algorithms using rounding and sample average approximation. We show algorithm performance using numerical experiments.

■ WA45

Level 1 -101E

Factors in Hospital Productivity

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Jillian Berry Jaeker, Harvard Business School, Soldiers Field, Boston, MA, 02163, United States of America, jjaeker@hbs.edu

1 - Patient Revisit Intervals in Primary Care

Hessam Bavafa, Ph.D. Candidate, The Wharton School, University of Pennsylvania, Philadelphia, PA, United States of America, bavafa@wharton.upenn.edu, Christian Terwiesch

We study patient revisit intervals, i.e., how often patients come to their physician's office for follow up, as an important physician productivity measure. We explore the sources of variation in revisit intervals using a dataset of primary care encounters.

2 - Hurry Up and Wait: Differential Impact of Load on Patient Length of Stay

Jillian Berry Jaeker, Harvard Business School, Soldiers Field, Boston, MA, 02163, United States of America, jjaeker@hbs.edu

High work load impacts patient LOS, but prior OM studies have found conflicting results regarding direction. Thus, it is difficult to predict load's effects on productivity a priori, inhibiting effective capacity management in high load systems. We categorize load at 283 hospitals into current patient census (congestion) and incoming patients, decomposing the latter into its levels of pressure and predictability, and quantify the magnitudes and directions of change on LOS.

3 - Inpatient Bed Capacity Planning from the Perspectives of Hospitals and Regulators

Thomas Best, The University of Chicago, Booth School of Business, 1000 N La Salle Dr. Apt. 210, Chicago, IL, 60610, United States of America, tbest@chicagobooth.edu, Burhaneddin Sandikci, Don Eisenstein, David Meltzer

We first consider a hospital administrator who decides whether to partition care into focused wings. The administrator faces a trade-off between forming large wings to pool demand and capacity, and forming specialized wings to focus on a narrow range of care types. To inform this decision, we provide an optimization model and apply it to data from an urban teaching hospital. We next consider a regulator of bed capacity who aims to predict and control the effects of capacity changes on society.

4 - ICU Admission Control: An Empirical Study of Capacity Allocation and Patient Outcomes

Song-Hee Kim, PhD Candidate, Columbia University, New York, NY, United States of America, sk3116@columbia.edu, Carri Chan, Marcelo Olivares, Gabriel Escobar

We examine how congestion in the ICU can impact the care pathway of patients and, ultimately, patient outcomes. We develop a stylized model for ICU admission and use the insights gained to develop an empirical framework, in which instrumental variable approach is used to identify the effect of the endogenous admission decision. We estimate these models using a large data set from an integrated healthcare delivery system and discuss the results' substantial health and financial implications.

■ WA46

Level 1 -101F

Environmental Considerations in Business Operations-I

Contributed Session

Chair: Aysegul Toptal, Bilkent University, Department of Industrial Engineering, Ankara, Turkey, toptal@bilkent.edu.tr

1 - Does Take-back Legislation Make Environment Green when the Manufacturer Has the Option to Lease?

Ni Fang, Ph.D. Candidate, HEC Paris, Ch.149, Résidence Expansiel, 1, Rue de La Libération, Jouy en Josas, 78350, France, ni.fang@hec.edu, Andrea Masini

While product take-back regulation becomes increasingly popular to minimize the environmental impact of waste, its actual effects remain unclear. We analyze the impact of such regulation on firms that sell and lease durable products. We demonstrate that collection costs may generate arbitrage opportunities and lead to an increase in the quantity of products leased. We also show that, unless the quantity recycled exceeds a certain threshold, the regulation is not as beneficial as hypothesized.

2 - An Analysis of Product Specific vs. Company Wide Recycled Content Claims

Aditya Vedantam, PhD Student, Purdue University, 2601 Soldiers Home Road, Apt. 116, West Lafayette, IN, 47906, United States of America, avedanta@purdue.edu, Ananth Iyer, Paul Lacourbe

Manufacturers often make recycled content claims at the product level or on an aggregate level i.e. across products/brands. The latter is often advertised by companies in sustainability reports while the former appears as a label on product packaging. We explore conditions when manufacturers should make recycled content claims on a product basis or an aggregate basis, under supply uncertainty of recycled input and demand side benefits from B2B and environmentally conscious consumers.

3 - Design of Sustainable Bioenergy Based Industrial Symbiosis

Vinay Gonela, Student, North Dakota State University, 101 University Village, Fargo, ND, 58102, United States of America, vinay.gonela@my.ndsu.edu, Jun Zhang

In Industrial Symbiosis (IS), traditionally standalone bioethanol plants collaborate or collocate with other plants to efficiently utilize resources and reduce wastes for improved sustainability. A decision framework combining Linear Programming (LP) models and a Mixed Integer Linear Programming (MILP) model is proposed in order to determine optimal IS such that economic, environmental, and social aspects of sustainability for bioethanol plant are improved.

4 - Joint Decisions for Inventory Replenishment and Emissions Reduction Investment

Aysegul Toptal, Bilkent University, Department of Industrial Engineering, Ankara, Turkey, toptal@bilkent.edu.tr, Hasim Ozlu, Dincer Konur

In this study, a retailer's emissions reduction investment and inventory replenishment decisions are analyzed under different governmental regulations on carbon emissions. Three different carbon emission policies are considered, those are cap, tax, and cap and trade. Analytical and numerical results are obtained on the comparison of the different policies.

■ WA47

Level 1 -101G

Operations Management I: Contracting Arrangements

Contributed Session

Chair: Jianbo Qian, Ivey Business School, Western University, 1151 Richmond St., London, Canada, jqian42@uwo.ca

1 - Single Machine Scheduling Problem to Minimize Mean Completion Time

Ali Allahverdi, Professor, Kuwait University, PO Box 5969, Safat, 13060, Kuwait, ali.allahverdi@ku.edu.kw, Asiye Aydilek, Harun Aydilek

We address the single machine scheduling problem with random and bounded processing times with the objective of minimizing mean completion time. We propose several new heuristics. Experimentation analysis indicates that the proposed heuristics perform much better than the two existing heuristics. The errors of the proposed heuristics are much less than the best existing heuristics, and the computational times of the existing heuristics are much more than those of newly proposed heuristics.

2 - Analysis of Contractual Service Agreement (CSA) for Power Generation Machine using Natural Language

Dan Yang, Research Scientist, Global Research Center, GE, 1 Research Circle, Niskayuna, NY, 12309, United States of America, yangd@ge.com, Christina Leber, Luis Tari, Andrew Crapo, Aravind Chandramouli, Richard Messmer

The Contract Search Tool is a semantic search platform that enables effective analysis of complex CSAs for heavy duty machines such as gas turbines over many years. We perform text analysis to identify paragraphs containing implicitly stated provisions using legal concepts that have been defined in a semantic model. The tool can be applied to increase the speed of legal review, standardize legal knowledge across users, and reduce legal risk in contract review process.

3 - Principal Agent Contract for Maintenance Service

Shuo Zeng, University of Arizona, McClelland Hall 430, 1130 East Helen Street, Tucson, AZ, 85721, United States of America, shuozeng@email.arizona.edu, Moshe Dror, Moshe Shaked

We propose a Markov model for equipment maintenance contract between a service provider and a principal with mission-critical equipment in a classical setting of principal agent with a moral hazard. By assuming an infinite horizon contract and profit flow model we derive for risk-neutral principal the second-best solution for risk-neutral and risk-averse service providers.

4 - A Portfolio Rebalancing Signal for Keeping Investment Portfolios Appropriately Up-to-Date

Jongbin Jung, Yonsei University, 50 YonseiRo, Seodaemungu, Seoul, KR, 120-749, Korea, Republic of, olorin@yonsei.ac.kr, Seongmoon Kim

We propose a Portfolio Rebalancing Signal (PRS), that is used to help the investor decide the appropriate time for rebalancing an investment portfolio. The PRS is computed based on the accuracy of the portfolio's expected returns and realized returns. We present empirical results from 10 different markets around the world.

5 - Companion Diagnostic Co-development Contracts with Risk-averse/seeking Agents

Jianbo Qian, Ivey Business School, Western University, 1151 Richmond St., London, Canada, jqian42@uwo.ca, Mehmet Begen, Greg Zaric

We study co-development contracts for companion diagnostics between a large (pharmaceutical) company and a smaller (biotech) lab. The company owns a potentially profitable drug whereas the lab owns a technology which may lead to a companion diagnostic for the drug after more development effort. We use a principal-agent model with the company as the principal and the lab as the agent who may be either risk-averse or risk-seeking. We develop optimal contracts for this co-development setup.

■ WA48

Level 1 -101H

Behavioral Issues in OM

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Anton Ovchinnikov, University of Virginia, Darden School of Business, 100 Darden Blvd, Charlottesville, VA, 22903, United States of America, aovchinnikov@darden.virginia.edu

1 - Behavioral Tendencies in Revenue Management Decision Making

Bahriye Cesaret, University of Texas at Dallas, Jindal School of Management, 800 W. Campbell Dr., Richardson, TX, 75080, United States of America, bahriye.cesaret@utdallas.edu, Elena Katok

We consider the well known two-class revenue management (RM) problem, and study the problem under three different dynamics. We aim to see how human decision making is affected by the RM problem dynamics, and whether the decision making in RM context is sensitive to framing of the problem dynamics. If there exist any behavioral regularity in RM decision making, we want to know what implications do they have for the RM. We use controlled laboratory experiments as a research tool.

2 - Experimental Investigation of Salesforce Pricing Decisions

Rashmi Sharma, Pennsylvania State University, 463 A Business Building, University Park, PA, United States of America, ros5253@smeal.psu.edu, Elena Katok, Saurabh Bansal, Peter Rimshnick

We model sales force pricing decisions under the uncertainty of getting a contract, and various incentive schemes. We identify three different classes of projects, and the incentive schemes best suited for each class. Subsequently, we test pricing decisions in a laboratory environment to identify behavioral factors that influence sales force pricing decisions.

3 - Are Consumers Strategic? Experimental Study

Nikolay Osadchiy, Assistant Professor, Emory University, Robert Goizueta Business School, Atlanta, GA, United States of America, nikolay.osadchiy@emory.edu, Elliot Bendoly

Novel retail selling mechanisms involve a tradeoff between buying now vs later at a lower price. Recreating this setting in a laboratory, we observe a substantial fraction of subjects making decisions consistent with expected utility maximization. We find that subjects are particularly sensitive to whether the information about riskiness of the buy-later option is provided. Implications for revenue management are discussed.

4 - Impact of Inventory Risk on Market Prices

Anton Ovchinnikov, University of Virginia, Darden School of Business, 100 Darden Blvd, Charlottesville, VA, 22903, United States of America, aovchinnikov@darden.virginia.edu, Gal Raz

This paper demonstrates and explains a surprising effect: that an increase in the number of competing firms may lead to an increase in the equilibrium market price in a situation when firms compete on both price and quantity. Using the concept of quantal response equilibrium (QRE) we attribute this effect to inventory risk and examine how it changes depending on the number of competitors, the degree of their rationality, and the composition of market demand and firms' costs.

■ WA49

Level 1 -101I

Efficiency Concepts in MCDM, DEA, and Finance

Cluster: Tutorials

Invited Session

Chair: Pekka Korhonen, Professor, Aalto University School of Business, POB 21210, 00076 Aalto, Helsinki, Finland, Pekka.Korhonen@aalto.fi

1 - Efficiency Concepts in MCDM, DEA, and Finance

Pekka Korhonen, Professor, Aalto University School of Business, POB 21210, 00076 Aalto, Helsinki, Finland, Pekka.Korhonen@aalto.fi

Efficient points, sets, and surfaces play important roles in Data Envelopment Analysis (DEA), multiple criteria decision making (MCDM), and portfolio selection in finance. The tutorial stresses the differences and similarities by which efficiency concepts manifest themselves in each of the three areas.

■ WA50

Level 1 -101J

Remanufacturing

Contributed Session

Chair: Wee Meng Yeo, SIMTECH/A*STAR, 71 Nanyang Drive, Singapore, United States of America, wmyeo@simtech.a-star.edu.sg

1 - Jointly Consider Acquisition Price, Trade in Rebate and Selling Price in Remanufacturing Business

Lei Jing, National University of Singapore, 10 Kent Ridge Crescent, Singapore, Singapore, jinglei@nus.edu.sg, Boray Huang

In remanufacturing business, many customers who return their end-of-life products need to do replacement purchase. In this study, we consider the pricing decisions with the presence of replacement purchase. We argue that despite the acquisition price for return products and the selling price to new customers, remanufacturing company should offer a trade-in program to the replacement customer segment.

2 - Inventory Control with Demand Substitutions between Manufactured and Remanufactured Products

S. Phil Kim, Research Associate, University of Minnesota, 111 Church St. SE, Minneapolis, MN, 55455, United States of America, ksphil@umn.edu, J. George Shanthikumar, Seokcheon Lee

An interconnection between remanufactured and manufactured items arises by product substitutions; when remanufactured products are out-of-stock, manufactured products can be sold to the customers for remanufactured products at a discounted price. In this study, we analyze the optimal inventory policy, under the framework of periodic review inventory control system. We find that the optimal policy for production is state dependent make-up-to policy.

■ WA51

Level 1 -102D

Information and Route Choice

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Song Gao, University of Massachusetts, 214C Marston Hall, 130 Natural Resources Rd., Amherst, MA, 01003, United States of America, sgao@engin.umass.edu

1 - Choice Set Generation for Adaptive Route Choice Models in Large Scale Networks

Song Gao, University of Massachusetts, 214C Marston Hall, 130 Natural Resources Rd., Amherst, MA, 01003, United States of America, sgao@engin.umass.edu, Jing Ding, He Huang

Adaptive route choice models capture travelers' adaptation to real-time traffic information. We study choice set generation, the first step in developing a route choice model. A routing policy is the elementary alternative where online adaptation is imbedded in its definition. Two real life networks from Stockholm and Singapore are used. Link travel time distributions are generated from taxi GPS data. The quality of the choice sets is evaluated based on coverage and adaptiveness.

2 - Parking Search, Information, and Online Routing Problems
Shoupeng Tang, Unversity of Texas-Austin, Austin, TX, United States of America, shouptang@gmail.com, Tarun Rambha, Stephen Boyles, Avinash Unnikrishnan

In some urban areas, a substantial fraction of traffic volume consists of drivers searching for parking. We model this search process as a Markov decision process which can be efficiently solved with variants of the online shortest path problem, and consider alternative ways to reflect past history.

3 - Psychological Benefits of Real-time Travel Information on Route Choice Behavior – Preliminary Insights from Driving Simulator Experiment Data
Dong Yoon Song, Graduate Research Assistant, Purdue University, 3000 Kent Ave., West Lafayette, IN, 47906, United States of America, song50@purdue.edu, Srinivas Peeta

This study proposes a comprehensive framework to understand the psychological mechanisms associated with real-time travel information provided. A structural equation model with latent variables is adopted for analysis based on the revealed preference data from a driving simulator experiment and stated preference data from a survey. Three types of information-related stresses are identified as important factors to infer on driver's benefits from real-time travel information as well as conventional travel time savings.

4 - Value of Travel Information: Exploring Psychological Effects of Real-Time Travel Information on Traveler Decision-Making Behavior
Dong Yoon Song, Graduate Research Assistant, Purdue University, 3000 Kent Ave., West Lafayette, IN, 47906, United States of America, song50@purdue.edu, Srinivas Peeta, Yu-Ting Hsu

This study explores the value of real-time travel information in terms of how it may psychologically influence traveler route choice behavior. An analytical framework is developed and driving simulator-based experiments are used to observe and study traveler responses to the provided information. The experimental results highlight the importance of factoring the relevance of information and cognitive capabilities of travelers.

■ WA52

Level 1 -102E

Online Traveling Salesman Problems, and Variants

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Thibaut Vidal, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 32-D566, Cambridge, MA, 02139, United States of America, vidalt@mit.edu

1 - On-line Traveling Salesman with Duration and Distance Considerations
Thibaut Vidal, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Room 32-D566, Cambridge, MA, 02139, United States of America, vidalt@mit.edu, Patrick Jaillet

We consider on-line traveling salesman problems in which the objective is to minimize a weighted sum of completion time and total travel distance. This objective captures both the customer-centric time-to-service objective and the carrier costs. On-line algorithms are examined, and new upper and lower bounds on competitive ratios are introduced.

2 - Classic and Stochastic Online Traveling Repairman Problems
Daw-sen Hwang, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, United States of America, dawsen@mit.edu, Patrick Jaillet

We consider two problems related to the online Traveling Repairman Problem (TRP). First, we consider the classic online TRP and propose a novel deterministic online algorithm whose competitive ratio is lower than that of the best existing deterministic algorithm. Second, we consider a new variant of the online TRP in which we take into account a stochastic on-site service time. For any constant greater than 5.83, we construct online algorithms whose competitive ratios are at most that constant.

3 - Online Traveling Salesman Problem on Graphs
Swati Gupta, ORC, Massachusetts Institute of Technology, 77 Massachusetts Avenue, E40-149, Cambridge, MA, 02139, United States of America, swatig@mit.edu, Michel Goemans, Patrick Jaillet

We give a 3-competitive polynomial time algorithm for nomadic online TSP on undirected edge-weighted graphs. Requests arrive on the vertices of the given graph and can be served only after their release time. We further restrict the server to not re-route on an edge. This algorithm generalizes to metric spaces.

■ WA53

Level 1 -102F

Freight Transportation

Contributed Session

Chair: Allan Larsen, Technical University of Denmark, DTU Transport, Bygningstorvet 1, Kgs. Lyngby, Denmark, ala@transport.dtu.dk

1 - Evaluating Criticality of Intermodal Network Infrastructures using Flow Optimization
Mingzhou Jin, Associate Professor, The University of Tennessee at Knoxville, 405 East Stadium Hall, Knoxville, TN, 37996, United States of America, jin@utk.edu, Abdullah Al-Khaled, Xiaopeng Li

We present an optimization model that facilitates flows in an intermodal network with minimum cost to determine critical infrastructures. The model considers the congestion effects of each individual mode and transfer terminals. The nonlinear relationships between travel cost and volume are approximated as piece-wise linear functions to handle the computational burden. The criticality of an infrastructure element is measured by the increased cost (delay) incurred when it is disrupted.

2 - Strategic Barge Shipping Routing Design
Panagiotis Ypsilantis, Ph.D. Candidate, RSM, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, pypsilantis@rsm.nl, Rob Zuidwijk

We consider a multi-modal carrier that anticipates container transport demand between seaport and inland regions. The carrier has to strategically decide on his assets (Number and size of barges) and routing patterns in order to offer efficient and frequent inter-modal services under some user related time constraints. We formulate this situation as an MIP model and run experiments to assess the impact of routing configurations while considering scenarios on possible delays.

3 - Transfer Synchronisation in Multimodal Corridors
Allan Larsen, Technical University of Denmark, DTU Transport, Bygningstorvet 1, Kgs. Lyngby, Denmark, ala@transport.dtu.dk, Allan Olsen, Hanne Løhmann Petersen, Federico Farina

The EU financed GreCor project investigates green corridors in the North Sea region aiming to provide an efficient way of using multimodal transportation. We examine the multimodal transport operations and propose a cargo router, which finds the best way of routing through the network considering multiple objectives. We present a large neighbourhood search-based algorithm to adjust the schedules, aiming at improving the transfer opportunities and the synchronisation between modes.

■ WA54

Level 1 -103A

Real-Time Resource Management in Transportation

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47906, United States of America, sukkusur@purdue.edu

1 - Bike-sharing System: A Strategy to Dynamically Solve the Unbalancing Problem
Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, Binh Luong, Pulkit Parikh

A challenge problem in public bike-sharing system is the unbalance of bikes at stations. In this work, we present a strategy to dynamically deal with the problem by maximizing the level of users satisfaction while minimizing the cost to redistribute the bikes

2 - Static Repositioning in Bike-sharing System
Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, Binh Luong

In this paper, we develop a strategy for repositioning the bikes in a Bike Sharing System. The objective is to minimize the amount of unmet demand at the stations and at the same time, to minimize the cost of the repositioning given the capacity constraints.

3 - Exploring the Market of Tradable Energy Quotas for Personal Travel through Experimental Games

H. M. Abdul Aziz, Ph.D. Candidate, Purdue University, 150 Arnold Dr. Apt. 15, West Lafayette, IN, 47906, United States of America, haziz@purdue.edu, Satish Ukkusuri

We design an experimental game to understand the market mechanism under Tradable Energy Quotas (TEQs). The TEQs system describes a market where users can buy and sell carbon credits. The unit price and availability of carbon credits in the market influence the travel choices of the users. Through the experimental game we observe the temporal dynamics of credit price and resulting evolution in the travel choices.

■ WA55

Level 1 -103B

Scheduling II

Contributed Session

Chair: Christos Maravelias, Associate Professor, University of Wisconsin- Madison, 1415 Engineering Dr., Madison, WI, 53706, United States of America, christos@engr.wisc.edu

1 - Capacity Planning and Scheduling in Contact Centers with Large Turn Around Time

Sudhanshu Singh, Reseracher, IBM India Pvt. Ltd., GH-1/260, Paschim Vihar, New Delhi, De, 110063, India, sudsing3@in.ibm.com, Gyana Parija, Pranav Gupta

Requests arriving in a contact center have to be answered within a turn around time, which ranges from a few hours to days. Finding optimal headcount and creating schedules that adapt to variable demand, honor the business rules and meet a service level target is a non trivial problem. We propose methods of planning and scheduling which can solve problems involving more than hundred thousand minutes of weekly work in few minutes. We validate our scheme on real life scenarios using simulation.

2 - A Tabu Search Approach for Flexible Job Shop Scheduling with Sequence-dependent Setup Times

Tamer Abdelmaguid, Associate Professor, Cairo University, Mechanical Design and Production Dept., Faculty of Engineering, Giza, 12613, Egypt, tabdelmaguid@alumni.usc.edu

This paper addresses the makespan minimization in scheduling flexible job shops with separable sequence-dependent setup times. It is shown that a previously developed neighborhood search for flexible job shop scheduling is applicable to the studied problem under the assumptions of setup times' triangular inequality and smallness compared to processing times. A tabu search approach is presented and its performance is benchmarked against the lower bounds using a set of modified benchmark problems.

3- Valid Inequalities Based on Demand Propagation for Chemical Production Scheduling MIP Models

Christos Maravelias, Associate Professor, University of Wisconsin-Madison, 1415 Engineering Dr., Madison, WI, 53706, United States of America, christos@engr.wisc.edu, Sara Zenner

We first present a MIP model that can be used to address chemical production planning and scheduling problems in a variety of environments. To enhance the performance of the model, we present: (i) a constraint propagation algorithm for the calculation of tight bounds on the number of tasks and the production amount of materials; and (ii) four new types of tightening constraints based on these bounds. The proposed methods lead to computational improvements of 2-3 orders of magnitude.

■ WA56

Level 1 -103C

OR and Energy Development

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Bruno Flach, IBM Research Brazil, Av Pasteur 138 - 146, Rio de Janeiro, Brazil, bflach@br.ibm.com

1 - Improved Methodology for the Construction of Large-Scale Wind Turbine Power Curves

Krystel Castillo, Assistant Professor, The University of Texas at San Antonio, One Circle UTSA EB 3.04.54, San Antonio, TX, 78249, United States of America, krystel.castillovillar@utsa.edu, Jose Francisco Herbert Acero

This study examines methodologies for the construction of power curves considering turbulence intensity corrections, topographic effects, atmospheric stability, icing and fouling, natural degradation of blades, blocking effects and uncertainty. We propose a method to reduce the uncertainty of such curves by considering the concept of equivalent wind speed that improves energy production forecast. A case study is considered to validate the methodology.

2 - Optimal Risk Mitigation Strategies in Project Management

Carlos Raoni Mendes, IBM Research Brazil, Pontifical Catholic University of Rio de Janeiro, Av. Pasteur 138-146, Rio de Janeiro, RJ, 22290240, Brazil, craoni@br.ibm.com, Bruno Flach

The construction of large power plants entails a huge challenge in terms of project management involving owners, contractors and suppliers. Time, budget and resource constraints coupled with potential risk sources and inter-dependencies create a very complex environment. In this work, we describe the development of optimization models aimed at supporting the decision-making process faced by project managers.

■ WA57

Level 1 -103D

Smart Grid Integration and Analysis in the New Electrical Era

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Qipeng Phil Zheng, Assistant Professor, University of Central Florida, Industrial Engineering & Mngmt Systems, Orlando, FL, 32816, United States of America, qipeng.zheng@gmail.com

1 - Robust Optimization for Fuel Supply Chain

Anna Danandeh, University of South Florida, Tampa, FL, 33620, United States of America, annadanandeh@mail.usf.edu, Bo Zeng, Brent Caldwell

We consider a multi-period supply chain model which includes quality, heterogeneous unit specifications, environmental requirements and transportation issues. In order to capture uncertainties in those components, a robust formulation is proposed and some numerical results are presented to show the effectiveness of this model.

2 - Optimal Policy for Plug-In Hybrid Electric Vehicles Adoption

Emrah Ozkaya, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, eozkaya@purdue.edu, Paul Preckel, Andrew Liu

This study focuses on the dynamics between adoption of Plug-In Hybrid Electric Vehicles (PHEVs) and government policies. To find an optimal policy to promote such adoption, we build a discrete choice model to represent consumers' behavior in choosing a conventional vehicle versus a PHEV. To further capture the interaction between the transportation and energy sector (fuel, electricity, etc), we propose an iterative approach to integrate our model with an energy-system model (MARKAL).

3 - An Equilibrium Model for Distributed Energy Consumption Scheduling in Smart Grid

Lihui Bai, Assistant Professor, University of Louisville, Louisville, KY, United States of America, lihui.bai@louisville.edu, Guangyang Xu, Qipeng Zheng

We propose an equilibrium model to describe residential users' energy consumption behavior that explicitly considers users' possible preference on convenience over cost-saving. In the proposed user equilibrium model, each user maximizes his/her payoff consisting of convenience and cost, under the real-time pricing in a smart grid. Numerical results for the resulting mixed complementarity problem will be reported.

■ WA58

Level 1 -103E

Commitment, Competition, and Pricing in Power Markets

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Uday Shanbhag, Pennsylvania State University, 353 Leonhard Building, University Park, PA, 16802, United States of America, udaybag@engr.psu.edu

1 - Operation of Fully Renewable Electric Energy Systems

Antonio Conejo, University of Castilla-La Mancha, Department of Electrical Engineering, Campus Universitario, Ciudad Real, 13071, Spain, Antonio.Conejo@uclm.es, Miguel Carrion, Ruth Dominguez

Fully renewable electric energy systems are rare but for a number of reasons it is desirable that they become ubiquitous. We consider a fully renewable electric energy system, propose an optimal dispatching model for such system, and describe its associated pricing mechanism. This model relies on a two-stage stochastic programming problem, whose first stage represents the day-ahead dispatching and whose second stage represents actual operation under different renewable production scenarios.

2 - Scalable Schemes for Stochastic Nonlinear Unit Commitment Problems

Aswin Kannan, Ph.D. Student, Pennsylania State University, 3001 Plaza Drive, State College, PA, United States of America, aswinkannan1987@gmail.com, Uday Shanbhag

We consider the stochastic version of the unit commitment problem. Branching schemes tend to scale poorly when applied to such mixed integer optimization problems. We use an interior-point method that solves smoothed variants of the original problem. We also introduce cuts and Lagrangian relaxations to aid computing global solutions and coping with uncertainty and nonlinearity. Numerical tests suggest that the scheme scales well and computes global solutions for a majority of problems.

3 - Tests of Approximations to Unit Commitment in Planning Models

Saamrat Kasina, Student, The Johns Hopkins University, 3400 N Charles Street, Ames 319, Baltimore, MD, 21218, United States of America, bkasina1@jhu.edu, Sonja Wogrin, Ben Hobbs

Planning models must consider the impacts of generator and transmission investments upon operating costs. It is often impractical to solve full unit commitment models as subproblems. We ask what approximations to the unit commitment problem make it computationally efficient while still accurately characterizing energy and operating reserve prices and total costs. Numerical test cases are used to compare approximations and full commitment models.

4 - Nash Equilibria in Duopolistic Power Markets under Diverse Pricing and Uplift Mechanism

Uday Shanbhag, Pennsylvania State University, 353 Leonhard Building, University Park, PA, 16802, United States of America, udaybag@engr.psu.edu, Sean Meyn, Gui Wang

We consider a capacitated duopolistic power market in which firms bid their offer functions. Allocation decisions are specified through commitment problems while pricing is considered via either marginal cost or convex hull pricing mechanisms. Furthermore, most markets are complicated by varying uplift mechanisms. The resulting Nash games are characterized by discontinuous payoff functions and existence is not immediate. We investigate the existence of of Nash equilibria in such settings.

■ WA59

Level 1 -103F

Climate Change Mitigation and Power Generation

Contributed Session

Chair: Yingjue Zhou, Oklahoma State University, EN322, Oklahoma State University, Stillwater, OK, 74075, United States of America, yingjue.zhou@okstate.edu

1 - Modeling Conversion Efficiency For Competing PV Solar Technologies: Case of the U.S. Midwest

Lisa Bosman, College of Menominee Nation, N 172 Hyw 47/55, Keshena, WI, 54135, United States of America, lbbosman@uwm.edu, Wilkistar Otieno

The International Energy Agency indicated that solar energy is the fastest growing renewable energy technology. Over the years, there has been tremendous progress in the development of solar modules with varying conversion efficiencies. We present a statistical model of energy efficiencies for competing solar technologies considering inherent and environmental variability. For validation, we use real-time data from Argonne National Laboratories as a case study for the U.S. Midwest region.

2 - Vulnerability to Climate Change in Bangladesh: A District Level Analysis

Uttam Deb, Principal Scientist (Economics), International Crops Research Institute for the Semi-Arid Tropics, RP-MIP, ICRISAT, Patancheru, Andhra Pradesh, 502324, India, u.deb@cgiar.org, Cynthia Bantilan

Following IPCC (2001), district level vulnerability to climate change is identified and prioritized using indicators representing exposure, sensitivity and adaptive capacity. Latest available data on weather variables, agricultural activity, food security and farmers' income for all 64 districts of Bangladesh are used for estimation of indices.

3 - Power Generation Capacity Management under CO2 Consideration: A Real Options Approach

Chung-Hsiao Wang, LG&E and KU, 102 Spruce Ln, Louisville, KY, 40207, United States of America, chunghsiao@hotmail.com, K. Jo Min

The uncertainties on CO2 regulations are making the capital investment decisions difficult for electric power utilities. Under these circumstances, we utilize a real options approach to develop a strategic decision process for a utility's capital investment. The evolution of CO2 price will facilitate a utility's decisions to retire coal power plants, construct gas power plants, or install/upgrade emission control facilities.

4 - Impacts of the Renewable Portfolio Standard on Regional Electricity Markets

Yingjue Zhou, Oklahoma State University, EN322, Oklahoma State University, Stillwater, OK, 74075, United States of America, yingjue.zhou@okstate.edu, Tieming Liu

We examine the impacts of the renewable portfolio standard on regional markets. We consider a regional market with a power supplier that has capacity to generate renewable energy and access to green credit. We find close-form solutions for the optimal electricity price, and the black/green power outputs. The green power output increases when the TGC price increases or the black power cost increases. However, the impacts of RPS on the black/green power outputs depend on the cost functions.

■ WA60

Mezzanine - 100A

Joint Session DM/HAS: Statistical Learning and OR in Health Application

Sponsor: Data Mining & Health Applications

Sponsored Session

Chair: Sung Won Han, Research Scientist, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com

1 - Spatiotemporal Pattern Recognition of Multi-Channel Sensing Data for Health Applications

Chen Kan, University of South Florida, 4202 East Fowler Ave. ENC 1205, Tampa, FL, 33620, United States of America, chenkan@mail.usf.edu, Hui Yang, Gang Liu, Yun Chen

Multi-channel sensing data are increasingly available in healthcare environments. This paper presents a novel spatiotemporal warping approach to quantify the dissimilarity of multi-channel profiles of cardiovascular function. Furthermore, functional profiles from each patient are embedded as a node in a high-dimensional complex network. This, in turn, greatly facilitates the recognition of disease patterns and smart health management.

2 - A Systems Dynamics Model for Healthcare Acquired Infections

Reidar Hagtvedt, Assistant Professor of Mgt Sci. & Stats., University of Alberta, 2-43 Business Building, Alberta School of Business, Edmonton, AB, T6G 2R6, Canada, hagtvedt@ualberta.ca, Sarah Forgie

Healthcare Acquired Infections are complicated phenomena, despite the fact that every sub-problem is understood. Variability in pathogens, human behaviors and characteristics, and measurement problems, all contribute to the difficulty of teasing out the impact of any one change to the system on HAI-rates. We use systems dynamics to illuminate how the sub-systems interact and lead to infections. We use data from the literature and guidance from infection control specialists to specify the model.

3 - Dynamic Feature Analysis for the Classification of Pelvic Organ Prolapse

Iman Nekooyimehr, University of South Florida, 11313 N 51st street, Unit 308, Tampa, FL, 33617, United States of America, imannekooyimehr@yahoo.com, Stuart Hart, Susana Lai-Yuen

We present the analysis of dynamic-based features from medical images to improve the classification of pelvic organ prolapse cases. Pelvic organ prolapse is a common but poorly understood condition and its clinical diagnosis is currently inadequate. We analyze the movements of the pelvic organs to identify significant features for classification.

4 - Hospital Patient Rescuing Process Analysis: A Markov Chain Approach

Xiaolei Xie, Research Assistant, University of Wisconsin- Madison, 1513 University Avenue, Room 3247, Madison, WI, 53705, United States of America, xxie6@wisc.edu, Jingshan Li, Yue Dong, Colleen Swartz

In this talk, a continuous time Markov chain model is developed to study the patient rescuing process on the hospital floor. Using an iterative approach, steady state probabilities of patient status and provider interventions are obtained and system properties are investigated. What-if analysis is conducted to study the impact of operation changes and derive managerial insights.

5 - Estimation of Directed Acyclic Graphs under Poisson Log-normal Data for Gene Networks

Sung Won Han, Research Scientist, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com, Hua Zhong

Many expressions in gene networks are recorded as count data, which can be assumed to follow compounded Poisson data. This presentation discusses the estimation of the structure of the directed acyclic graph under the Poisson log-normal data by L_1-penalized likelihood approach. By Laplace integral approximation, we convert the penalized likelihood with Bayes framework into a simple objective function, and use two iterative optimization steps to estimate the structure of the graph.

■ WA61

Mezzanine - 100B

Data Mining I

Contributed Session

Chair: Pavel Izhutov, Stanford University, 736 Escondido Rd., Apt. 203, Stanford, CA, 94305, United States of America, izhutov@stanford.edu

1 - A Framework for Service Performance Improvement using Online Reviews

Alexandra Medina-Borja, Program Director/ Associate Professor, NSF/University of Puerto Rico at Mayaguez, 2507 Fowler Street, Falls Church, VA, 22046, United States of America, alexandra.medinaborja@upr.edu

On line reviews are increasingly used by customers to finalize purchase decisions. There is increasing evidence that bad reviews are particularly damaging in the service industry. The large amount of online data, the diversity of linguistic opinions and the imprecise nature of the comments makes it difficult to take effective action to correct problems. A framework to extract, classify and evaluate damaging comments using Fuzzy Logic and Data Envelopment Analysis is presented.

2 - What Drives Marketplace Effectiveness and Growth? An Empirical Investigation.

Pavel Izhutov, Stanford University, 736 Escondido Rd., Apt. 203, Stanford, CA, 94305, United States of America, izhutov@stanford.edu, Haim Mendelson

Online marketplaces are becoming increasingly important mechanisms for matching supply and demand. This paper presents initial findings from a marketplace for services (in particular, a tutoring vertical). Using a rich data-set, we study the drivers of marketplace growth and the factors that lead to successful matching of supply and demand.

■ WA62

Mezzanine - 100C

Joint Session QSR/ENRE: Reliability and Prediction in Renewable Power Systems

Sponsor: Quality, Statistics and Reliability & Energy, Natural Resources and the Environment

Sponsored Session

Chair: Eunshin Byon, Assistant Professor, University of Michigan, 2773 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, ebyon@umich.edu

Co-Chair: Arash Pourhabib, Research Assistant, Texas A&M University, TAMU 3131, College Station, TX, 77840, United States of America, arash.pourhabib@tamu.edu

1 - Optimally Replacing a Wind Turbine Component in a Partially-Observed Environment

Jeffrey Kharoufeh, Associate Professor, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, jkharouf@pitt.edu, John Flory

Motivated by wind energy applications, we present a partially-observed Markov decision process model for optimally replacing a component that operates and degrades in a partially-observable random environment. The first of two models assumes that replacement costs are fixed, while the second model considers costs that depend on the environment's state during the replacement interval. We show that control-limit policies are optimal in both cases and illustrate them using numerical examples.

2 - Reliability Analysis of Large-scale Wind Farms

Young Myoung Ko, Assistant Professor, Pohang University of Science and Technology, 77, Cheongam-ro, Nam-gu, Pohang, 790-784, Korea, Republic of, youngko@postech.ac.kr, Eunshin Byon

As a large-scale wind farm with hundreds of turbines forms a new trend in wind power systems, reliability evaluation of an entire wind farm becomes important in operations decision-making. We propose a novel methodology for analyzing the stochastic behavior of wind farm reliability and show its effectiveness through numerical studies.

3 - Estimating the Endogenous Power Curve for Wind Turbines

Yu Ding, Professor, Texas A&M University, TAMU 3131, College Station, TX, 77843, United States of America, yuding@iemail.tamu.edu, Giwhyun Lee, Marc Genton, Le Xie

Power curves can be used for characterizing energy production efficiency of a wind turbine. Using the raw power data, however, cannot accurately reflect the changes in a turbine because besides the wind speed, many ambient factors potentially affect the power output of a turbine. This talk presents our recent work on estimating the endogenous power curve, the curve decided by a turbine's own aerodynamics, after the influence from the ambient factors is controlled for.

4 - Importance Sampling for the Reliability Evaluation with a Stochastic Computer Model

Youngjun Choe, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109-2117, United States of America, yjchoe@umich.edu, Eunshin Byon, Nan Chen, Vijay Nair

We extend the theory of importance sampling to estimate a system's reliability with a stochastic computer simulation. The proposed method aims to minimize the variance of failure probability estimator in a complex stochastic system. The method is applied to evaluate the reliability of a wind turbine based on computationally expensive aerodynamic simulations. The implementation results show that significant computational gains can be obtained, compared with other methods.

■ WA63

Mezzanine - 100D

Bayesian Methods for Industrial Statistics
Co-sponsored with ISBA/Industrial Statistics Section

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Refik Soyer, Professor of Decision Sciences & Statistics, George Washington University, 2201 G Street, NW, Washington, DC, 20052, United States of America, soyer@gwu.edu

1 - What do Bayesian Testing of a Sharp Hypothesis and Reliability Models Have in Common?

Ehsan Soofi, Distinguished Professor, University of Wisconsin-Milwaukee, Sheldon B. Lubar School of Business, PO Box 742, Milwaukee, WI, 53021, United States of America, esoofi@uwm.edu, Nader Ebrahimi, Nima Jalali

Bayesian testing and some well-known reliability models involve singular distributions. The traditional indices of relationship fail to distinguish the dependence of singular models such as Marshall-Olkin and the exponential autoregressive bivariate distributions. The information measure of dependence is not defined. A weighted average of the mutual information indices for the singular and absolutely continuous parts provides a common metric for comparing the dependence of these models.

2 - Bayesian Analysis of Accelerated Life Tests with a Generalized Eyring Time Transformation Function

Thomas Mazzuchi, Professor and Chair, George Washington University, 1776 GSt NW, Washington, DC, 20012, United States of America, mazzu@gwu.edu, Refik Soyer, Selda Kapan Ulusoy

In this article we perform a Bayesian analysis of accelerated life testing data with two stress variables using the generalized Eyring time transformation function. Selection and definition of the prior distributions will be developed as well as the areas for posterior analysis using MCMC methods.

3 - On a Bounded Bimodal Two-sided Distribution Fitted to the Old-Faithful Geyser Data

Johan Rene van Dorp, Professor, GWU, 1776 G Street, NW, Washington, DC, United States of America, dorpjr@gwu.edu, Donatella Vicari

In this talk we shall develop a novel family of bimodal univariate distributions (also allowing for unimodal shapes) and demonstrate its use using the well known and almost classical data set involving durations and waiting times of eruptions of the Old-Faithful Geyser in Yellowstone park. In the process, we develop a bivariate distribution using a copula technique and compare its fit to a mixture of bivariate normal distributions also fitted to the same bivariate data set.

4 - Bayesian Analysis of Markov Modulated Queues

Refik Soyer, Professor of Decision Sciences & Statistics, George Washington University, 2201 G Street, NW, Washington, DC, 20052, United States of America, soyer@gwu.edu, Suleyman Ozekici, Joshua Landon

We consider a Markovian queueing model where both customer arrival process and the service process are modulated by an external environmental process. We present the Bayesian analysis of the stochastic system. We illustrate the implementation of our model and the Bayesian approach by using queueing data.

■ WA64

Mezzanine - 100E

Reliability: Maintenance and Warranty

Contributed Session

Chair: Maryam Hamidi, University of Arizona, 3121 E Bellevue St., unit2, Tucson, AZ, 85716, United States of America, mhamidi@email.arizona.edu

1 - Maintenance Outsourcing Contracts for a System with Backup Machines

Hakan Tarakci, University of North Texas, 1155 Union Circle #305339, Denton, TX, 76203, United States of America, hakan.tarakci@unt.edu, Subramaniam Ponnaiyan, Shailesh Kulkarni

Consider a system with multiple components. A contractor performs maintenance-related activities: Minimal repair whenever a component breaks down and preventive maintenance for the whole system at pre-determined times. Revenue is earned during up-times. A backup machine allows production to continue during minimal repairs. Coordinated and uncoordinated system profits are compared.

2 - Fleet Sizing and Spare Parts Stocking when Maintenance Takes Time

Rob Basten, University of Twente, PO Box 217, Enschede, 7500 AE, Netherlands, r.basten@utwente.nl, Joachim Arts

Owners of fleets of assets require a certain number of assets to be operational at any given point in time. Unavailability of assets is due to active maintenance time (replacement of failed components by spare parts) and unavailability of spare parts. To ensure with a certain probability that sufficient assets are available at any given point in time, an investment in both spare parts and spare assets is required. We discuss the problem of deciding on how to invest.

3 - Optimal Scheduling of Inspections in Condition-based Maintenance Models

Ji Ye Janet Sung, PhD Candidate, University of Toronto, 5 King's College Road, Toronto, On, M5S3G8, Canada, janet@mie.utoronto.ca, Dragan Banjevic

In traditional condition-based maintenance practices, regular inspections are considered a given requirement. Most results, however confirm that the machine is in good health. We consider that there are savings to be had in the number of inspections. We use a Markovian process to model the system covariates, and a proportional hazards model for risk of failure. We motivate future inspections by the system condition, the cost and time of inspections to find the optimal decision.

4 - Outsourcing Maintenance Services Based on Cooperative and Conflict Models

Maryam Hamidi, University of Arizona, 3121 E Bellevue St., Unit2, Tucson, AZ, 85716, United States of America, mhamidi@email.arizona.edu, Haitao Liao

Contracting out maintenance service to a service provider becomes more and more popular. Due to the uncertainties in failures and spare part logistics, doing a contract between the owner of a system and the service agent can be quite complex. In this paper, a game-theoretic model is presented to handle this joint decision making process. Detailed analyses and numerical examples are provided for both cooperative and conflicting decision making paradigms.

■ WA65

Mezzanine - 100F

Transit Operations

Contributed Session

Chair: Felipe Lagos, Magister Student, Universidad de Chile, Av. Republica 701, Santiago, Chile, felipelg206@gmail.com

1 - Computing Path Travel Time Distributions from Transit System Data

Felipe Lagos, Magister Student, Universidad de Chile, Av. Republica 701, Santiago, Chile, felipelg206@gmail.com, Fernando Ordonez, Daniel Espinoza

Routing recomendations requires a representative characterization of the distribution of travel time along paths on a street network. In this work we build such distribution from GPS data. We show when travel times along arcs can be represented by lognormal distributions and explore methods to determine the distribution along a path. The objective is to use these travel times as proxys for the time that will be experienced by emergency services. We present results on real data.

2 - Improving Bus Priority by using Mid-block Pre-signals

Haoyu Chen, University of California, Berkeley, 416D McLaughlin, UC, Berkeley, CA, 94720, United States of America, williamchenthu@gmail.com, Weihua Gu, Michael Cassidy

The deployment of bus signal priority schemes and exclusive bus lanes can significantly reduce bus delays at intersections, however at the cost of diminishing the intersection's car-carrying capacity. We propose a strategy that uses a mid-block pre-signal to restore the intersection's car capacity eroded by these bus priority strategies. Analytical models are developed for examining this strategy under various conditions. Results show that our strategy is beneficial for both buses and cars.

■ WA66

Mezzanine - 100G

Networks, Analytics and Beyond

Sponsor: Information Systems

Sponsored Session

Chair: Jeong-ha Oh, Assistant Professor, Georgia State University, 35 Broad Street, PO Box 4015, Atlanta, GA, 30302, United States of America, jhoh@gsu.edu

1 - Determinants of Crowdfunding Success: A Social Influence Perspective

Eun Ju Jung, PhD Candidate, Michigan State University, Broad College of Business, Dept. of Accounting&Information systems, East Lansing, United States of America, jung@bus.msu.edu, Vallabh Sambamurthy, Anjana Susarla

The emergence of crowdfunding could unleash substantial changes in the business environment. Worldwide crowdfunding raised almost $2.7 billion in 2012 (crowdsroucing.org). Although there are several academic studies on crowdfunding, it is important to highlight the collective evaluation mechanisms of crowdfunding. In this paper, we empirically investigate the impact of social influence and network characteristics on the likelihood of funding success, using data collected from Kickstarter.com.

2 - The Impacts of Network Characteristics on Content Diffusion in Social Media

Hyelim Oh, McGill University, 1001 Sherbrooke St. W., Montreal, Canada, hyelim.oh@mail.mcgill.ca, Animesh Animesh, Alain Pinsonneault

This study investigates how network characteristics influence content diffusion in social media. Specifically, we focus on individual-level content retransmission decision and examine how network characteristics between a sender and a receiver affect the likelihood of a receiver's content retransmission in Twitter's subscription network. We provide practical implications for designing effective social media advertising campaigns.

3 - Differential Influence of Blogs Across Different Stages of Decision Making

Harpreet Singh, University of Texas-Dallas, Richardson, TX, United States of America, harpreet@utdallas.edu, Rohit Aggarwal

We study the differential influence of online user generated content (UGC), specifically blogs, across the multiple stages of decision-making of venture capitalists: screening stage, choice stage, and contract stage. In particular, this study indicates that blogs can help managers in getting their products/services selected at the screening stage, but beyond that, blogs do not help directly.

4 - Hospital Characteristics, Health Information Technology, and Stage One Meaningful Use

Jingyun Li, University of Texas at Dallas, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, jxl097620@utdallas.edu, Kristin Jenkins, Indranil Bardhan

We study the characteristics of hospitals that are likely to achieve Stage 1 meaningful use (MU). We find that acute care, for-profit and non-profit hospitals are more likely to achieve Stage 1 MU. Hospitals with EMR and those that use health IT are also likely to achieve Stage 1 MU. Our results suggest strong associations between hospital ownership, health IT and Stage 1 MU compliance.

■ WA67

Mezzanine - 100H

Abduction and Perceptions

Sponsor: Decision Analysis

Sponsored Session

Chair: Michael Cassidy, Professor, Marymount University, 2807 North Glebe Road, Arlington, VA, 22207, United States of America, mcassidy@marymount.edu

1 - Abduction, Perceptions, "Thin Slices," and Intuition

Michael Cassidy, Professor, Marymount University, 2807 North Glebe Road, Arlington, VA, 22207, United States of America, mcassidy@marymount.edu

The purpose of this session is to explore these commonalities, as conceptualized by thinkers often unaware of parallel inquiry and investigation. In particular, the session will include consideration of Peirce's concept of abduction; the Lens Model, as developed by Brunsik and his heirs; bounded rationality, explored by Simon; heuristics, as characterized by Kahneman and Tversky, and others in that research tradition; and the concept of thin slices, as investigated by Ambady and her colleagues. Exploring the similarities among these largely insular traditions will contribute to enriched understanding across disciplines, and result in a more robust and nuanced interpretation of a topic with significant practical implications. Session one, led by John Rohrbaugh, will focus on both Brunsik's Lens Model and Policy Capture, with particular attention to decisions addressed in multi-person situations. Stephen Weinberg will consider the topic from the vantage of Herbert Simon's notion of bounded rationality. The concluding session, led by Michael Cassidy, will draw on Rohrbaugh's and Weinberg's presentations, and attempt a systematic comparison of these and other vantages. To integrate the three presentations, each author will draw on a fictitious law-enforcement example involving human deception to illustrate salient principles and concepts.

2 - Group Abduction: Assessing the Performance of Expert Teams

John Rohrbaugh, Professor, University at Albany, State University of New York, 1400 Washington Ave., Albany, NY, 12222, United States of America, jrohrbaugh@albany.edu

Nearly 100 years have passed since the death of Charles Sanders Peirce, an American philosopher who introduced the concept of abduction as an alternative to both deductive and inductive forms of reasoning. Whereas deduction invokes the certainty of premises to establish the certainty of conclusions and whereas induction requires that all assertions be accompanied with an explicit acknowledgement of the risk of error, Peirce characterized abductive reasoning as the process of making guesses largely unguided by the rules of logic or statistics. Later in the 20th century as functional psychology emerged as a cognitive science, theoretical interest in perception and judgment was supported by more focused empirical study. Egon Brunswik's lens model provided a formal, testable representation of probabilistic functionalism that, by the late 1900s, had been elaborated and extended by Kenneth Hammond as social judgment theory. Using several components of the lens model to form a multilevel theory, this paper illustrates how the relationship between strategy and achievement can be viewed as the basic unit of both individual and group functioning. This is illustrated specifically by considering a case in which the legitimacy of an informant must be judged by law enforcement officials working independently and, subsequently, as an expert team.

3 - Too Much Information: Behavioral Economic Approaches to Cognitive Overload

Stephen Weinberg, University at Albany, Albany, NY, United States of America, sweinberg@albany.edu

Economic theory often requires agents to engage in perfect Bayesian reasoning. Behavioral economics has long struggled with the challenge of how individuals construct their beliefs even though they lack the cognitive capacity to process all the information available to them. Two major threads of the "bounded rationality" literature have emerged. In one thread, including Herbert Simon's "satisficing" model, people use simple decision rules to decide how to act. These models strip away the classic economic framework of constrained optimization, instead assuming people rely on intuition in various ways. In a second thread, people optimally decide how to allocate their scarce attention, focusing their energy on high-impact information and spending more time on problems with a high return-to-cognition. These models typically assume that the "cognitive allocation" task is done intuitively. This paper contrasts these two approaches in the context of a judgment task by law enforcement officials.

■ WA68

Mezzanine - 100I

Organizational Change and Decision Making under Uncertainty

Sponsor: Decision Analysis

Sponsored Session

Chair: Richard Staats, Senior Fellow CSA SSG, US Army, Box 1232, McLean, VA, 22101, United States of America, dr_games@yahoo.com

1 - Structural Changes in North American Fertilizer Logistics

Sumadhur Shakya, Graduate Student/Spatial Transportation Analyst, North Dakota State University, Upper Great Plains Transportation Inst., Fargo, ND, 58102, United States of America, sumadhur.shakya@ndsu.edu

Traditionally U.S. imports Nitrogen Fertilizers.Lower cost of natural gas from fracking has increased the incentive for producing N-fertilizers domestically. Changing geographic production of corn has shifted consumption patterns. Proposed plants can tap cheaper natural gas from fracking or use by-products from ethanol to produce N-fertilizer.This translates to changes in demand and supply of Nitrogen fertilizers in the U.S.,structurally and geographically,with potential to allow future exports.

2 - Managing Change in Organizations where Mission Failure is not an Option

Richard Staats, Senior Fellow CSA SSG, US Army, Box 1232, McLean, VA, 22101, United States of America, dr_games@yahoo.com

This paper describes the fundamentals for successful organizational change in practical terms. The paper includes both theory and practical suggestions from experience. The methods used are derived from a variety of sources ranging from David Garvin to Sun Tsu. The foundation for most organizational change is measurement of the proper factors. The paper describes a standard metrics attribute approach that has been applied in practical situations world wide.

■ WA69

Mezzanine - 100J

Auctions and Mechanism Design I

Contributed Session

Chair: EunSu Lee, Associate Research Fellow, Upper Great Plains Transportation, 1616 12th Ave. N, #210, Fargo, ND, 58102, United States of America, eunsu.lee@ndsu.edu

1 - Maverick Buying: Eliminate, Participate, Leverage?

Alexander Rothkopf, University of Wuerzburg, Stephanstrafle 1, Wuerzburg, Germany, alexander.rothkopf@uni-wuerzburg.de, Richard Pibernik

Non-compliance with frame contracts, known as maverick buying (MB), is a major concern to many firms that are trying to achieve scale economies in purchasing. We study a model that characterizes the misalignment of incentives in modern purchasing organizations and show why traditional mechanism fail to eliminate MB. We propose a new mechanism that aligns interests of the firm and the MB agent. We study when firms benefit from letting purchasing agents violate the frame contract agreements.

2 - Multi-attribute Sourcing Mechanisms in E-markets

Shi Kui Wu, Lecturer, University of Windsor, 401 Sunset Ave., OB-413, Windsor, ON, N9B 3P4, Canada, skwu@uwindsor.ca

Various mechanisms are proposed to enable and improve e-sourcing practices. The present work addresses a challenging and practical issue in designing and selecting appropriate mechanisms for e-sourcing that involves multiple attributes. It adopts a multi-disciplinary approach to formulate and test feasible mechanisms with a set of design parameters and contextual factors. The result provides an analytical framework for e-market designers and a strategic guideline for e-sourcing practitioners.

Wednesday, 11:00am - 12:30pm

■ WB01

Level 2 - Room 200A

Optimization Methods for Portfolio Selection and Trade Execution

Cluster: Optimization in Finance

Invited Session

Chair: Javier Pena, Professor of Operations Research, Tepper School of Business, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, jfp@andrew.cmu.edu

1 - Robust Portfolio Liquidation with Margin Requirement

Jingnan Chen, University of Illinois at Urbana-Champaign, Champaign, IL, United States of America, jchen98@illinois.edu

We consider the robust portfolio liquidation with margin requirement. An optimal execution strategy is in the sense that we can meet the cash requirement with the least effort. We first focus on selling a portfolio of purely basic assets. Then we extend to the portfolio consisting of both basic assets and the derivatives.

2 - Computational Stochastic Programming for Trade Execution under Downside Risk Measures

Somayeh Moazeni, Princeton University, Princeton, NJ, United States of America, somayeh@Princeton.EDU, Thomas Coleman, Warren Powell, Yuying Li

Computing an optimal stochastic dynamic programming solution under a downside risk measure and constraints is a challenging task. We develop two tractable computational approaches to derive approximate stochastic trading strategies in the presence of temporary and permanent price impacts, possibly several constraints, and under a downside risk measure particularly VaR or CVaR. We compare performance of these approaches and discuss structure of computed trading strategies and their costs.

3 - Stochastic Multi-portfolio Optimization: Threshold Boolean Programming Model and Solution

Ran Ji, George Washington University, 2201 G St., NW, Funger Hall 415, Washington, DC, 20052, United States of America, jiran@gwmail.gwu.edu, Miguel A. Lejeune

We propose multi-portfolio optimization models including each a joint chance constraint with multi-row random technology matrix representing discretely distributed random asset returns. The probability of each portfolio's return below a level is upper-bounded by a low value. We use threshold Boolean method to obtain linear inequalities defining sufficient conditions for the chance constraint to hold, derive a deterministic equivalent MIP reformulation. Computational results will be presented.

■ WB02

Level 2 - Room 200B

Reduced-order Methods for Nonlinear and Stochastic Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Guanghui Lan, Assistant Professor, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, 32611, United States of America, glan@ise.ufl.edu

1 - Accelerated Gradient Methods for Nonconvex Nonlinear and Stochastic Programming

Saeed Ghadimi, Ph.D. Candidate, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, 32611, United States of America, sghadimi@ufl.edu, Guanghui Lan

In this talk, we present an accelerated gradient (AC-GD) method and establish its complexity results for solving a class of nonlinear nonconvex optimization problems. We show that, if the objective function contains both smooth convex and noconvex terms, choosing larger stepsizes for the AC-GD method allows us to have a unified analysis for both convex and nonconvex terms. We also generalize this method for solving the above class of problems under stochastic programming (SP) setting.

2 - Stochastic Block Mirror Descent Methods for Nonsmooth and Stochastic Optimization

Cong Dang, Ph.D. student, University of Florida, Department of Industrial and Systems Eng, Gainesville, FL, United States of America, congdd@ufl.edu, Guanghui Lan

We propose Stochastic Coordinate Descent algorithms (SCDA) for general convex and non-convex stochastic optimization. We also present the convergence analysis of SCDA for variant types of problems.

3 - Acceleration Schemes for a Class of Variational Inequality Problems

Yuyuan Ouyang, University of Florida, 358 Little Hall, Gainesville, FL, 32611, United States of America, ouyang@ufl.edu, Yunmei Chen, Guanghui Lan

We present a novel method to solve a class of deterministic and stochastic variational inequality (VI), and accelerate the solution through identification and special treatment of the potential functional components. With the identification, we incorporate a multi-step acceleration scheme into the prox-method by Nemirovski to solve the problem. We show that our method not only achieves optimal rate of convergence, but may also be of higher order than the optimal rate with respect to general VI.

4 - On the Complexity of Large-scale Convex Programming under a Linear Optimization Oracle

Guanghui Lan, Assistant Professor, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, 32611, United States of America, glan@ise.ufl.edu

We consider a generic class of iterative optimization algorithms which can only perform linear optimization over the feasible region. We present the low complexity bounds for these algorithms, and establish the (near) optimality of the classic conditional gradient (CG) method under different cases. We also introduce some new variants of the CG method and demonstrate their advantages for solving certain convex optimization problems, e.g., those with box-type constraints.

■ WB03

Level 2 - Room 200C

Recent Progress in the Theory of Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Amitabh Basu, University of California-Davis, Davis, CA, United States of America, abasu@math.ucdavis.edu

1 - On Some Generalizations of Split Cuts

Diego Alejandro Moran Ramirez, Georgia Institute of Technology, 225 North Ave. NW, Atlanta, GA, 30332, United States of America, dmoran@gatech.edu, Sanjeeb Dash, Oktay Gunluk

Split cuts form a well-known class of valid inequalities for mixed-integer programming problems (MIP). Cook et al. (1990) showed that the split closure of a rational polyhedron P is again a polyhedron. In this paper, we extend this result from a single rational polyhedron to the union of a finite number of rational polyhedra. We also show how this result can be used to prove that some generalizations of split cuts, namely cross cuts, also yield closures that are rational polyhedra.

2 - On the Chvatal Gomory Closure of a General Convex Set

Daniel Dadush, New York University, 15 Washington Pl, Apt. 5N, New York, NY, 10003, United States of America, dndadush@gmail.com, Juan Pablo Vielma, Santanu Dey

We show that the Chvatal-Gomory (CG) closure of a thin & totally closed convex set is finitely generated. This extends and unifies all known results with respect to the finite generation of the CG closure. A convex set is thin if it is contained in the Minkowski sum of its its tangent cone and a bounded set, and is totally closed if every linear projection maps it to a closed set. In particular, this class contains all compact convex sets and unbounded polyhedra.

3 - On the Diameter of Lattice Poytopes

Alberto Del Pia, ETH Zurich, R‰mistrasse 101, Zurich, 8006, Switzerland, alberto.del.pia@ifor.math.ethz.ch, Carla Michini

We prove a theorem on the diameter of lattice polytopes. This result improves on previous result by Kleinschmidt and Onn, and implies a tight bound on the diameter of half-integral polytopes.

4 - Semi-continuous Knapsack Polyhedron with Multiple GUB Constraints

Daniel Espinoza, Universidad de Chile, Department of Industrial Engineering, Republica 701, Santiago, Chile, daespino@dii.uchile.cl

We consider a polyhedron were variables are either zero, or take values in a bounded set; these variables are linked by a knapsack constraint and several disjoint clique inequalities. In this talk we present valid inequalities for this set, multi-dimensional sequence-independent lifting functions, separation heuristics and computational experiments performed on real-world unit-commitment instances. This works builds on previous works by the authors and also from lifting techniques developed by Zeng and Richard.

■ WB04

Level 2 - Room 200D

At the Intersection of Convex Optimization and Integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

1 - Distributionally Robust Multistage Inventory Models with Moment Constraints

Linwei Xin, PhD Student, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, lwxin@gatech.edu, David A. Goldberg, Alexander Shapiro

We study a multistage distributionally robust inventory problem, when only the mean, variance, and support are known for the demand. It is known that if the policy maker is allowed to recompute her policy choice after each stage(i.e. dynamic formulation), a basestock policy is optimal. In contrast, if the policy maker is not allowed to recompute her policy choice(i.e. static formulation), far less is known. We define weak and strong time consistency in this setting and provide novel conclusions.

2 - MIP Techniques for Product Pricing under a Reservation Price Model

Tor Myklebust, University of Waterloo, 200 University Ave. W., Waterloo, ON, N2L 6S7, Canada, tmyklebu@csclub.uwaterloo.ca, Levent Tuncel, Malcolm Sharpe

We discuss techniques for solving instances of a certain product pricing problem based on reservation prices. We detail some primal heuristics, a column generation technique, several classes of cuts, and a preprocessing step. We will present results of some computational experiments with these techniques. Some of these techniques are problem-specific, but we will indicate generalisations to a class of bilinear MIPs where appropriate.

3 - Intersection Cuts for Nonlinear Integer Programming

Sina Modaresi, University of Pittsburgh, Pittsburgh, PA, United States of America, sim23@pitt.edu, Juan Pablo Vielma, Mustafa Kilinc

We study the generalization of split and intersection cuts from Mixed Integer Linear Programming to the realm of Mixed Integer Nonlinear Programming. Constructing such cuts requires calculating the convex hull of the difference of two convex sets with specific geometric structures. We introduce two techniques to give precise characterizations of such convex hulls and use them to construct split and intersection cuts for several classes of sets.

4 - On Minimal Valid Inequalities for Mixed Integer Conic Programs

Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

We study structured mixed integer sets with a general regular cone and introduce minimal inequalities. Under mild assumptions, these inequalities together with the trivial conic ones are sufficient to describe convex hull. We study their characterization via necessary, and sufficient conditions for an inequality to be minimal; and establish relations with the support functions of sets with certain structure, which leads to efficient ways of showing a given inequality is minimal.

■ WB05

Level 2 - Room 200E

Stochastic Optimization I

Contributed Session

Chair: Mehmet Ertem, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, ME Building, Madison, WI, 53705-1735, United States of America, ertem@wisc.edu

1 - Modeling Unwanted Inflation Key Factors to Forecast Inflation

Tina Rezvanian, Author, Northeastern Illinois University, 3701 Keenan Lane, Glenview, IL, 60026, United States of America, T-Rezvanian@neiu.edu, Alireza Dorestani

The dilemma of unwanted inflation has always been one of the main issues that involves economics. Identifying the indicators that influences inflation and tracking them over time helped worthy to have a closer view of the unwanted inflation. This paper involves developing a model to predict and analyze inflation trends using a combination of Time Series Analysis and Stochastic Modeling approach. We conduct a sensitivity analysis to identify key parameters that impact the dynamics of the model.

2 - Optimal Bidding for Price-making Hydro-electric Producers

Gregory Steeger, Division of Economics and Business, 816 15th Street, Golden, CO, 80501, United States of America, gsteeger@mines.edu, Steffen Rebennack

What is the revenue-maximizing bidding schedule for price-making hydro-electric producers in a deregulated market? We assume a bid-based market with day-ahead price and/or quantity bidding. We consider stochastic reservoir inflows and model the price-maker's bidding decision via a combination of Lagrangian Relaxation and stochastic dual dynamic programming. With multiple price-maker hydro producers, our optimal solution is a set of quantity bids that constitutes a Nash Equilibrium.

3 - Travel Salesman Problem with Stochastic Times: Models and Solution Approaches

Shuguang Liu, Associate Professor, SUNY New Paltz, 1 Hawk Dr., New Paltz, NY, United States of America, liush@newpaltz.edu

TSP with stochastic elements has attracted considerable research attention in the recent past. While most work in the has focused on probabilistic TSP where the customer occurrence is stochastic, precious little effort has been devoted to the research on TSP with random time. We provide a overview, examine a variety of modeling frameworks and their solution approaches, and suggest future research directions.

4 - Some Explicit Results for the Distribution Problem of Stochastic Linear Programming

Afrooz Ansaripour, University of Oklahoma, 202 W. Boyd St., Room 124, Norman, OK, 73019, United States of America, afrooz.ansaripour@ou.edu, Hillel Kumin

We consider the "wait and see" problem of stochastic linear programming to find a closed form expression for the distribution of the maximum value of the objective function where either the objective function coefficients or the right hand side coefficients have known distributions. Explicit results for this problem are very difficult to obtain. In this paper, we obtain explicit results for problems whose objective coefficients or right hand side coefficients have 4 different distributions

5 - A Stochastic Network-interdiction Model for Cyber Security

Mehmet Ertem, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, ME Building, Madison, WI, 53705-1735, United States of America, ertem@wisc.edu, Vicki Bier

We propose a general defender-attacker model for security of computer networks, using attack graphs to represent the possible attacker strategies and defender options. The defender's objective is to maximize the security of the network under a limited budget. To represent the ability of the attacker to launch multiple attempts, we represent the attacker's success or failure on any one arc of the attack graph probabilistically, and formulate the problem as a multiple-stage stochastic program.

■ WB06

Level 2 - Room 200F

Evacuation and Location Problems on Networks

Sponsor: Optimization/Networks

Sponsored Session

Chair: Chrysafis Vogiatzis, Ph.D. Student, University of Florida, Weil 303, Gainesville, FL, 32608, United States of America, chvogiat@gmail.com

1 - P-median and P-dispersion Problems – A Bi-criteria Analysis

Golbarg Tutunchi, NC State University, Dept. of ISE, Raleigh, NC, 27695, United States of America, gkazemi@ncsu.edu, Fatemeh Sayyady, Yahya Fathi

We consider the p-median problem and the p-dispersion problem in the context of a bi-criteria location problem. We propose a mathematical programming approach to obtain a collection of non-dominated solutions (efficient front) with respect to these two objectives, and propose a Lagrangean heuristic procedure for solving larger instances of the problem. We demonstrate the effectiveness of this approach through a comprehensive computational experiment.

2 - Large-scale Evacuation through Network Clustering

Chrysafis Vogiatzis, Ph.D. Student, University of Florida, Weil 303, Gainesville, FL, 32608, United States of America, chvogiat@gmail.com, Jose L. Walteros, Panos Pardalos

In this talk, we present a way to decompose large-scale networks into smaller subproblems that can then be recombined to obtain a high-quality solution to the, inherently difficult, problem of evacuation. We discuss real-life examples, and provide computational results that prove the success of our efforts.

3 - How to Define the Decision Variables: Model Building for Allocation Type Problems

Boris Goldengorin, Visiting Professor, University of Florida, 7951 NW 47th Way, Gainesville, United States of America, goldengorin@ufl.edu, Panos Pardalos

In this talk we show why a usual choice of decision variables in the Simple Plant Location Problem (SPLP) is less efficient than inverse one. Based on the corresponding pseudo-Boolean polynomial of the SPLP we derive the most compact MILP model for the SPLP and its variations. Our computational study of the MILP model for the SPLP and its variations shows that many large sized SPLP type instances are solved exactly by means of a general purpose solver like Cplex.

4 - New Formulations and Exact Algorithms for the Capacitated p-Center Problem

Hatice Calik, Research Assistant, Bilkent University, Bilkent Universitesi, Endustri Muh., Ankara, 06800, Turkey, calik@bilkent.edu.tr, Bahar Kara, Oya Karasan, Barbaros Tansel

The capacitated p-center problem is an NP-Hard facility location problem that requires locating p facilities on a given network and assigning clients with demands to facilities respecting capacities so that the maximum distance between a client and its facility is minimized. We propose new mathematical formulations and exact algorithms which utilize our formulations. We are able to solve problems with up to 1817 nodes while the largest problem solved in the literature has 402 nodes.

■ WB07

Level 2 - Room 200G

Stochastic Programming Models for Biomass Supply Systems

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Sandra Eksioglu, Associate Professor, Mississippi State University, PO Box 9542 206 McCain Engineering Bld., MSSTATE, MS, 39762, United States of America, sde47@ise.msstate.edu

1 - A Mean-risk Stochastic Programming Model for Retrofitting Transportation Network

Jie Lu, Clemson University, 102 Calhoun St., Apt. 130, Clemson, SC, 29631, United States of America, jlu3@clemson.edu

We formulate a mean-risk two-stage stochastic programming model for allocating the retrofitting resources for a transportation network to reduce social losses. Due to the numerical challenges, a decomposition based progressive hedging method is considered to improve the solution efficiency, especially when handling large-scale problems. In this talk, we will present preliminary results of a numerical example based on Sioux-Falls network.

2 - Stochastic Optimization of a Biomass-to-Biofuel Supply Chain under Multiple Uncertainties

Atif Osmani, Graduate Research Assistant, North Dakota State University, Industrial Engineering Dept., CIE Building, Fargo, ND, 58102, United States of America, Atif.Osmani@my.ndsu.edu, Jun Zhang

A biomass-to-biofuel supply chain is studied under multiple uncertainties in supply, demand and prices. An integrated two-stage stochastic mixed-integer linear programming model is proposed to optimize the supply chain logistics decisions to maximize the expected profit by considering constraints over the full range of the uncertain environment. Decomposition technique is used to make the stochastic problem computationally tractable and to obtain optimal solutions within reasonable time frame.

3 - Biorefinery Supply Chain Network Design under Uncertainty and Evaluation of the Impacts of Policies

Narges Kazemzadeh, Iowa State University, 3030 Black Engineering, Ames, IA, 50011, United States of America, kazemzad@iastate.edu, Guiping Hu

The goal of this study is to design a biofuel supply chain considering uncertainty in feedstock yield, fuel market price and logistic costs. To deal with the stochastic parameters, we develop two-stage stochastic programming models in which Conditional Value at Risk is considered as a risk measure to control shortage of demand. We also investigate the impacts of policies on the proposed models. A case study in Iowa is conducted to demonstrate the applicability and efficiency of the models.

■ WB08

Level 2 - Room 200H

Methods and Implementations for the Computationally Challenging Supply Chain Management

Sponsor: Computing Society

Sponsored Session

Chair: Lijian Chen, Assistant Professor, University of Louisville, 5241 Craigs Creek Dr, Louisville, KY, 40241, United States of America, lijian.chen@louisville.edu

1 - Nested Preprocessing Monte Carlo Sample for the Multi-stage Stochastic Programming

Lijian Chen, Assistant Professor, University of Louisville, 5241 Craigs Creek Dr, Louisville, KY, 40241, United States of America, lijian.chen@louisville.edu

We present an improvement to the Sample Average Approximation (SAA) for the multi-stage stochastic programming. Our approach, named nested preprocessing, reduces the sample size without compromising the solution quality. We quantify each scenario by its unique geometric information to identify redundant scenarios. The nested preprocessing approach works on a pre-generated Monte-Carlo sample and this approach inherits all of SAA's nice theoretical properties. Numerical results are presented.

2 - Solving Cancer Drug Shortage – A Chance Constrained Model
Shanling Li, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, PQ, H3A1G5, Canada, shanling.li@mcgill.ca, Xiaowen Chang, Huifu Xu, Dali Zhang

Drug shortages have been major concern to cancer patients. In this research, we propose to develop a chance-constrained model to describe cancer drug shortage problem and in the model, we consider demand uncertainty for cancer drugs, uncertain availability of generic drug supplies and some operational issues such as purchasing and inventory holding costs. The objective is to minimize total expected cost. We present the computational techniques to simplify solution procedures.

3 - Decomposition Heuristic for Inbound Lean Logistics
Jeffrey Ohlmann, Associate Professor, University of Iowa, Tippie College of Business, S372 John Pappajohn Business Bldg, Iowa City, IA, 52242, United States of America, jeffrey-ohlmann@uiowa.edu, Michael Fry

We consider the problem of designing a comprehensive plan for inbound logistics that faces a third-party logistics provider. We incorporate lean logistics principles into a heuristic approach that decomposes the decision of mode choice, cross-docking, visit frequency determination, and vehicle routing and scheduling.

■ WB09

Level 2 - Room 200I

Marketing Analytics

Sponsor: Analytics Section

Sponsored Session

Chair: Yimin Liu, Marketing Analytics Supervisor, Ford Motor Company, One American Road, Dearborn, MI, 48126, United States of America, yliu59@ford.com

1 - A Program Evaluation Framework for Business Analytics
Paul McCarthy, Senior Economist, Ford Motor Credit Company, Dearborn, MI, United States of America, pmccart4@ford.com

This paper addresses the challenges presented in evaluating the impact of changes in business practices where there is little or no control of experimental design. By structuring the analytics / business interaction around an explicit framework for quantifying and reporting results, we have been able to improve the quality of the analytics while increasing buy-in from the non-analytic partners, and facilitated a learning process with feedback to new program design.

2 - Vehicle Sharing Programs in China: User Preferences on Travel Modes and Vehicle Types
Wen Jin, Tsinghua University, Department of IE, Shunde Building Roon 519A, Beijing, 100084, China, jinw11@mails.tsinghua.edu.cn, Erica Klampfl, Hai Jiang, Yimin Liu

Vehicle sharing is a sustainable travel mode which has made great success in decreasing the number of vehicles in some of the cities in North America and Europe. This research investigates consumers'preferences among different travel modes when vehicle sharing comes into China. Also consumers' preferences towards types of vehicles and affiliated equipment when using vehicle sharing. The results of this research can be used for government and automakers when bringing in vehicle sharing to China.

3 - Taking Surveys while Driving using Human Machine Interface System, Does it Work? A Focus Group Study
Yimin Liu, Marketing Analytics Supervisor, Ford Motor Company, One American Road, Dearborn, MI, 48126, United States of America, yliu59@ford.com

The purpose of the focus group is to capture car drivers' attitudes towards technology in cars in general as well as their receptiveness to technology that would enable them to take surveys in their cars during driving using the Ford SYNC system. Appropriate incentives, right driving conditions and good timing/context could sway drivers into taking surveys in their cars. Safety is a major concern shared by participants towards technology use in car (including taking surveys).

4 - Sensitivity of Vehicle Market Share Predictions to Alternative Discrete Choice Model Specifications
C. Grace Heckmann, Graduate Research Assistant, Carnegie Mellon University, 5000 Forbes Avenue, Scaife Hall, Pittsburgh, PA, 15213, United States of America, christine.grace.heckmann@gmail.com, Jeremy Michalek, W. Ross Morrow, Yimin Liu

We investigate variation and accuracy of new light-duty vehicle market share predictions for multinomial, mixed and nested logit models over a variety of utility function specifications. We find that the predictions of the best models outperform random guessing yet retain substantial error, share predictions are sensitive to the presence of utility covariates but less sensitive to the form, and models selected for best fit have comparable forecast error to those with the best forecasts.

■ WB10

Level 2 - Room 200J

Joint Session Inform-ED/Analytics: Teaching Business Analytics: Best Practices 2

Sponsor: INFORM-ED & Analytics

Sponsored Session

Chair: Eric Huggins, Fort Lewis College, 1000 Rim Drive, Durango, CO, United States of America, huggins_e@fortlewis.edu

1 - Motivating and Framing "Analytics": A Fusion of Decision and Information Analysis
Patrick Noonan, Professor & Associate Dean, Emory University, Goizueta Business School, 1300 Clifton Road NE, Atlanta, GA, 30322, United States of America, patrick.noonan@emory.edu

When teaching analytics at a core, introductory level, there is no need to reinvent the wheel. With a well-crafted integrating framework that puts decision-making at the forefront, some topics from traditional statistics, decision analysis and OR/MS can be combined seamlessly to provide a stronger, more intuitive foundation than either topic in isolation.

2 - Insights from Teaching Business Analytics to MBAs in a Flipped Style
Stephen Powell, Dartmouth College, Amos Tuck School of Business, Hanover, NH, United States of America, Stephen.G.Powell@tuck.dartmouth.edu, Galit Shmueli

We have taught business analytics to MBAs in both traditional and flipped classroom styles, and in different settings. We will discuss the pros and cons of the flipped approach and its applicability to different schools and cultures.

3 - Observations Along the Road to Business Analytics
Cliff Ragsdale, Bank of America Professor, Virginia Tech, 1007 Pamplin Hall, Blacksburg, VA, 24060, United States of America, Cliff.Ragsdale@vt.edu

Several strategies exist for the integration of business analytics in undergraduate business and MBA degree programs. This paper discusses the changes being contemplated and implemented at the author's institution and discusses reactions of faculty, students, recruiters, and academic advisory boards to date.

■ WB11

Level 2 - Room 201A

Demand-driven Marketing

Contributed Session

Chair: Saman AlaniAzar, Wayne State University, ISE Department, Detroit, United States of America, saman.alaniazar@wayne.edu

1 - Customer Differentiation via Pipeline Stock Flexibility
Guangyang Yang, PhD Student, Erasmus University Rotterdam, Buizenwerf 175, Rotterdam, 3063AD, Netherlands, gyang@ese.eur.nl, Adriana Gabor, Sven Axsäter

In response to customer specific time guarantee requirements, service providers can offer differentiated services. However, conventional customer differentiation methods often lead to high holding costs and may have some practical drawbacks. We therefore propose to use pipeline stock flexibility as a differentiation option. The effect of different customer differentiation methods on the customer-focused service performance metrics is evaluated.

2 - Optimal Production and Demand Management through Dynamic Bundling and Pricing
Sang Jo Kim, PhD Candidate, MIT Zaragoza International Logistics Program, Calle Bari 55, Edificio Nayade 5, Zaragoza, 50197, Spain, sjkim@zlc.edu.es, Youyi Feng

We investigate an optimal decision-making of a manufacturer that makes and sells two distinguishable products. The firm also bundles products to stimulate sales as well as adjusts the prices dynamically. Optimal joint decisions on inventory replenishment, bundling/unbundling and pricing of the products show certain effective structures and draw meaningful managerial insights.

3 - Brand-name Licensing when Selling to Snobbish Customers
Prateek Raj, PhD Student, University College London, Dept. Management Science and Innovation, Gower Street, London, WC1E 6BT, United Kingdom, p.raj.12@ucl.ac.uk, Kenan Arifoglu

Licensing its brand name to a noncompeting firm is an important decision for a brand-owning firm (BOF) selling its primary product to exclusivity-seeking (snobbish) consumers since on the one hand, it increases the revenue but, on the other hand, it decreases brand's exclusivity and hence the appeal of BOF's primary product to consumers. We study this problem and characterize cases where licensing is and is not optimal for the BOF selling snob-appeal products.

4 - Demand Modeling and Capacity Planning for Innovative Short Life Cycle Products

Saman AlaniAzar, Wayne State University, ISE Department, Detroit, United States of America, saman.alaniazar@wayne.edu, Ratna Babu Chinnam, Alper Murat, Karl Kempf

We study demand modeling and capacity planning for innovative short life-cycle products. After proposing a new stochastic version of Bass model, we developed a modeling and solution approach that can be employed for deriving optimal policies in both strategic (one-time) and dynamic capacity expansions. Extensions of the model for multi-generation and multi-sourcing scenarios are discussed, as well. Using the proposed stochastic bass model, we present managerial insights for the expansion model.

■ WB12

Level 2 - Room 201B

Portfolio Analysis

Contributed Session

Chair: Onur Babat, Graduate Student, Lehigh University, 217 West Packer Avenue, Apt:102, Bethlehem, PA, 18015, United States of America, onur.babat@lehigh.edu

1 - Fair Pricing of International Indices

Gonzalo Cortazar, Pontificia Universidad Catolica de Chile, Vicuna Mackenna 4860, Santiago, Chile, gcortaza@ing.puc.cl, Juan-Pablo Gonzalez, Juan-Pablo Araujo

We address how to obtain fair prices for an international index when there are no market prices for a given day. Using the last price inducing stale prices and short-term arbitrage opportunities. We assume returns are a linear function of a common set of latent factors and the model is estimated using the Kalman filter. We estimate models with one to three factors using 43 international indices. Model errors compared with those using the last observed price are reduced between 10 and 50%.

2 - Study Comparing the Leading vs. Lagging Efficient Frontier DMU's Based on Recent Tech Company IPO's

John Ryan, Southern Methodist University, 4300 N. Central Expressway, Suite 365, Dallas, TX, 75206, United States of America, jaryan@smu.edu, Stephen Szygenda

This study analyzes technology companies who's initial public offering occurred between 1998-2009. The research utilizes DEA to identify the leading and lagging efficient frontier DMU's based on their 3 years post IPO performance. From this work a methodology for assessing the significant differences between the leading and lagging DMU's will be defined with the goal of improving the performance and hit rate of venture capital and private equity investments in technology companies.

3 - Volatility Harvesting in Practice

Vassilii Nemtchinov, Parametric, 1918 8th Ave., Suite 3100, Seattle, WA, 98101, United States of America, vnemtchinov@paraport.com, Paul Bouchey

We discuss portfolio construction that improves compound returns over time through diversification and rebalancing. We focus on the practical issues that arise during implementation and propose simple rules to mitigate these challenges. The methodology could be used to construct a portfolio of stocks, sectors, countries or other risk factors. It could be used in conjunction with optimization to control estimation error and reduce exposure to unknown risk with a minimum of portfolio turnover.

4 - Term Structure of Implied Distributions

Jinming Xie, The Chinese University of Hong Kong, Dept. of Sys. Eng. & Eng. Manag., Shatin, Hong Kong - PRC, jmxie@se.cuhk.edu.hk, Duan Li

Financial events are heavily driven by people's expectation about the future. Due to the blossom of financial derivatives, the prices of options contain information about the future return for an underlying asset. We develop implied spot distribution and implied forward distribution to form a term structure of the implied distributions from option data numerically. We then apply the term structure of implied distributions to a portfolio selection problem under the utility maximization framework.

5 - Linear Solution Scheme for Cardinality Constrained Portfolio Allocation Models

Onur Babat, Graduate Student, Lehigh University, 217 West Packer Avenue, Apt:102, Bethlehem, PA, 18015, United States of America, onur.babat@lehigh.edu, Luis F. Zuluaga

The cardinality-constrained portfolio allocation models can be formulated as a MIQP when the risk is measured by the portfolio return variance. Thus, it can be difficult to solve especially for the large scale instances. To tackle this inherent difficulty, we propose a linear solution scheme based on Benders reformulation. The effectiveness of the linear solution schemes is illustrated by numerical experiments.

■ WB13

Level 2 - Room 202A

Disaster and Emergency Management: Practices

Contributed Session

Chair: Xiuli Qu, Associate Professor, North Carolina A&T State University, 1601 E. Market Street, Greensboro, NC, 27411, United States of America, xqu@ncat.edu

1 - Modeling Analysis to Investigate Natural Disasters in Japan and Indonesia

Novia Budi Parwanto, National Graduate Institute for Policy Studies (GRIPS), 7-22-1 Roppongi, Minato-ku, Tokyo, 106-8677, Japan, noviabudi@bps.go.id, Tatsuo Oyama

This study aims at quantitatively investigating the past trend of natural disasters, focusing upon tsunamis and earthquakes which occurred in Japan and Indonesia with respect to their occurrences and human casualties. We apply mathematical policy analysis techniques as a natural disaster risk analysis to mitigate the casualties caused by these natural disasters. The study is concluded with some policies and strategies to strengthen community resilience to face natural disasters in the future.

2 - Service Recovery an Analytic Network Process Approach

Fariborz Partovi, Professor, Drexel University, 101 North 33rd Street, Academic Buiding, Philadelphia, PA, 19104, United States of America, Partovi@drexel.edu

In January of 2012 a cruise ship owned by a British-American cruise company, experienced a tragedy resulting in the loss of 32 lives. In lieu of this, the company failed to handle this situation properly. In this paper we will develop a methodology for service recovery to maintain customer satisfaction when unpredictable circumstances occur.

3 - Factors Influencing Collaboration Among Humanitarian Organizations: An Empirical Analysis

Mohammad Moshtari, University of Lugano, Via Giuseppe Buffi 13, Lugano, CH-6904, Switzerland, mohammad.moshtari@usi.ch

This paper investigates the factors influencing horizontal collaboration performance among international NGOs conducting humanitarian operations. Theories and concepts from interorganizational relationships constitute the study's theoretical foundation. Data are collected through a web-survey of NGOs in 25 countries, and I use structural equation modeling to examine the proposed hypotheses.

4 - An Interactive Decision Making Tool for Evaluating and Comparing Port Security Screening Policies

Xiuli Qu, Associate Professor, North Carolina A&T State University, 1601 E. Market Street, Greensboro, NC, 27411, United States of America, xqu@ncat.edu, Lauren Davis, Jessye Bemley, Carrie Boles, Eric King, Raquel Teasley

Port security is a significant part of homeland security. Effective port security screening policies are needed to reduce the risk of potential threats and maintain port productivity. In this study, an interactive decision making tool is developed to help port policy makers to compare vessel and cargo screening policies. An experiment leveraging this tool is then conducted to compare alternative policies in terms of port productivity, inspection costs and detection of potential threats.

■ WB14

Level 2 - Room 202B

Supply Chain: Shipping and Transportation

Contributed Session

Chair: EunSu Lee, Associate Research Fellow, Upper Great Plains Transportation, 1616 12th Ave. N, #210, Fargo, ND, 58102, United States of America, eunsu.lee@ndsu.edu

1 - Models for Automotive Supply Chain Planning

Sherif Masoud, PhD Candidate, Clemson University, 110 Freeman Hall, Clemson, SC, 29630, United States of America, smasoud@g.clemson.edu, Scott Mason

We present an integrated production and transportation planning problem from the automotive supplier industry to minimize total cost. Our problem contains sequence-dependent setups on parallel machines, auxiliary resource assignments, and multiple types of costs. We introduce a model that recommends time-phased production, inventory, and shipping decisions. Considering an industrial case study, we describe a heuristic-based approach for solving this problem in a reasonable amount of time.

2 - Port Choice for U.S. Import Commodities
EunSu Lee, Associate Research Fellow, Upper Great Plains Transportation, 1616 12th Ave. N, #210, Fargo, ND, 58102, United States of America, eunsu.lee@ndsu.edu

This study investigates the port choice behavior for the U.S. import commodities. It applies logit regression for measuring sequential commodity flow from the foreign trade partners to the U.S. marine ports through geographical districts. This study explains that port characteristics, portal districts, origins, and inland accessibilities at destinations determine each shipment destination.

3 - Two-stage Network Optimization with Variable Arc Costs
Ali Kefeli, Operations Research Consultant, Kimberly-Clark, 1400 Holcomb Bridge Rd., Roswell, GA, 30076, United States of America, akefeli@ncsu.edu, Zack Yang

In international supply chains, inter-country duties are one of the important factors that cannot be overlooked. Duties make the arc costs variable in nature and this poses an interesting problem that has not been explored extensively in literature. We propose a two-phase approach to solve the network problem with variable arc costs where, we first solve a series of shortest path problems to establish the shipping cost between demand and supply nodes and then solve a modified LP.

■ WB15

Level 2 - Room 203

Servitization: Integrated Product-Service Strategies

Sponsor: Service Science

Sponsored Session

Chair: Morris Cohen, Professor, University of Pennsylvania, Wharton School, 546 JMHH, Philadelphia, PA, 19104, United States of America, cohen@wharton.upenn.edu

1 - Causes of Product Recall in the Automotive Industry: An Empirical Investigation
Serguei Netessine, Professor, INSEAD, Boulevard de Constance, Fontainebleau, France, serguei.netessine@insead.edu, Rachna Shah, George Ball

Negative impact of product recalls is well-documented. On the other hand, little is know about systematic factors that cause recalls. By combining the recalls data with plant-level production data, we demonstrate that recalls are more likely to happen at plants operating under high utilization and high option variety.

2 - Product Quality or Service Quality? The Impact of Customer Heterogeneity
Jose Guajardo, Assistant Professor, Haas School of Business, University of California Berkeley, Berkeley, United States of America, jguajardo@haas.berkeley.edu, Morris Cohen

We study how customer heterogeneity influences the effect of product quality and service quality perceptions on customer loyalty, in an application in the consumer electronics industry. We find that customer characteristics have a significant moderating effect, and document significant heterogeneity in service-sensitivity in the population.

3 - Servitization: Disentangling the Impact of Service Business Model Innovation on Manufacturing Firm Performance
Ivanka Visnjic, Professor, ESADE Business School, Spain, ivanka.visnjic@gmail.com, Bart Van Looy

As manufacturing businesses operate in an ever more competitive, global economy where products are easily commoditized, innovating by adding services to the core product offering has become a popular strategy. Contrary to the economic benefits expected, recent findings pinpoint implementation hurdles that lead to a potential performance decline, the so-called 'servitization paradox'.

4 - Profitability and Environmental Implications of Servicization
Vinayak Deshpande, Associate Professor, University of North Carolina, Kenan-Flagler School, Chapel Hill, NC, United States of America, Vinayak_Deshpande@kenan-flagler.unc.edu, Adem Orsdemir, Ali Parlakturk

Servicization is a novel strategy which involves selling the functionality of a product or service, rather than a product itself. It has long been promoted as a green strategy, but critics contend that such strategies may not increase profits and could actually harm the environment. We research when servicization leads to a win-win situation for both the firm and the environment. We endogenize product durability and consumer use decisions and allow the servicizing firm to segment the market.

5 - Switching To Servicizing Systems: Agent Based Modeling Approach
Vered Blass, Lecturer, Tel Aviv University, PO Box 39787, Tel Aviv, 61397, Israel, vblass@post.tau.ac.il, Igor Nikolic, Reinier van der, Tzruya Chebach

Servicizing systems which are grounded on consuming functions rather than products could lead to economic and environmental benefits. The fact that both production and consumption patterns can be modified provide a unique opportunity to test under what conditions Servicizing can happen and the consequences of such shift. We present agent based approach and a model that was developed for testing the emergence of Servicizing systems and measure the potential consequences at the value chain level.

■ WB16

Level 2 - Room 204

Approximate Dynamic Programming in Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Steven Shechter, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, steven.shechter@sauder.ubc.ca

1 - Managing Patient Admissions in a Neurology Ward
Saied Samiedaluie, McGill University, Montreal, QC, Canada, saied.samiedaluie@mail.mcgill.ca, Vedat Verter, Dan Zhang, Beste Kucukyazici

We study patient admission policies in a neurology ward recognizing multiple types of patient and model it in an average cost dynamic programming framework. By solving the dynamic program, we are looking for the dynamic admission policy that provides the best care for all patients in light of limited bed availability. We present an integrated approach which combines queuing theory and approximate dynamic programming and compare the performance of our approach to other heuristic policies.

2 - Approximate Dynamic Programming for Adapting Radiotherapy to Hypoxia
Fatemeh Saberian, University of Washington, 5209 15th Ave. NE Apt. No 303, seattle, Wa, 98105, United States of America, saberian@uw.edu, Archis Ghate, Minsun Kim

We present an approximate dynamic programming methodology to adapt to the spatiotemporal evolution of tumor hypoxia. Results on prostate, lung and head and neck cancer cases will be discussed.

3 - Appointment Scheduling under Patient Preference and No-show Behavior
Nan Liu, Assistant Professor, Columbia University, New York, NY, 10032, United States of America, nl2320@columbia.edu, Serhan Ziya, Jacob Feldman, Huseyin Topaloglu

We develop a model to schedule patient appointments over time. On each day, we decide which appointment days to make available for the patients, who then choose one offered or leave without an appointment. Patients may cancel or not show up for their scheduled service. The objective is to maximize the expected daily net "profit", i.e., the "revenues" of serving patients less the "cost" of maintaining the service. We consider both the static scheduling policy and the dynamic one.

4 - Optimal Allocation of Operating Room Time between Surgical Specialties
Stephanie Carew, University of British Columbia, 2053 Main Mall, Vancouver, BC, Canada, stephanie.carew@sauder.ubc.ca, Mahesh Nagarajan, Steven Shechter

We examine how to allocate operating room hours to different surgical specialties at the British Columbia Children's Hospital. This is a longer-run planning decision which has major effects on the wait time experience of the patient population. To evaluate policies, we construct and validate a simulation model of patient arrival and appointment processes. We then apply optimization and dynamic programming techniques to recommend improved allocation policies.

■ WB17

Level 2 - Room 205A

New Service Development

Sponsor: Service Science

Sponsored Session

Chair: Cheng-Jhe Lin, Assistant Professor, National Taiwan University of Science and Technology, No.43, Sec. 4, Keelung Rd., Da'an Dist., Taipei, 106, Taiwan - ROC, robert_cjlin@mail.ntust.edu.tw

1 - Multilevel Simulations for Adoption of New Technology: A Potential Tool for Planning and Management

Anand N Vidyashankar, George Mason University, 4000 University Drive MS4 A7, Fairfax, VA, 22030, United States of America, avidyash@gmu.edu, Martin Nielsen, Jie Xu

Discrete event simulations are effective tools for assessing the trade-off between cost, efficiency, and accuracy for adopting emerging technologies. We describe multilevel simulations to model the adoption of new technology over current methods in parasitology. We illustrate our approach to the adoption of PCR over larval assay methods for identifying co-infection. The decision of interest concerns adopting technologies that are accurate and reliable that can be sustained across time.

2 - Performance of Pinch Gesture Operations in a 2-dimensional Synchronous Task on a Multi-touch Screen

Cheng-Jhe Lin, Assistant Professor, National Taiwan University of Science and Technology, No.43, Sec. 4, Keelung Rd., Da'an Dist., Taipei, 106, Taiwan - ROC, robert_cjlin@mail.ntust.edu.tw

Gestural operations on multi-touch screens have become popular but, the pinch gesture, one of the most frequently used gestures, have not been thoroughly studied for its time performance and accuracy. The study manipulates 4 influential factors: target distance, target width, moving direction and target allowance in a factorial experiment, to see their effects on the time and accuracy of a 2-dimensional synchronous task performed with the pinch gesture.

3 - Analysis of Automobile Driving Behavior Data for New Service Concept Development

Min-Jun Kim, POSTECH, Quality Systems Lab., Dept. of IME, San 31, Hyoja-dong, Nam-gu, Pohang, 790-784, Korea, Republic of, minjun@postech.ac.kr, Chie-Hyeon Lim, Kwang-Jae Kim

The digital tachograph (DTG) is a device to collect the operational data of an automobile. The driving patterns of a driver can be extracted by analyzing the DTG database. This talk presents an analysis of the driving patterns extracted from the DTG database and their impacts on the actual accident rates in Korea. This research would serve as a basis for developing the driving safety enhancement service concept.

■ WB18

Level 2 - Room 205B

Advances in Queueing Models II

Contributed Session

Chair: Babak Haji, PhD Student, USC, 2553 Dearborn Dr., Los Angeles, United States of America, bhaji@usc.edu

1 - Optimal Pricing for VIP with Resource Sharing in Visible and Invisible Queue

Xin Li, PhD Candidate, Macau University of Science and Technology, Taipa, Macau, robinlixin@gmail.com, Zhaotong Lian

We study a queuing model which consists of the VIP and general server in visible or invisible queue. If some customers are in general queue but the VIP queue is empty, a customer in general queue will be invited to the VIP server at general price (called as resource sharing). we find that without resource sharing, invisible queue benefits the server, however with resource sharing, visible queue benefits the server.

2 - Non-asymptotic Analysis for System with Reneging and Balking

Katsunobu Sasanuma, Ph.D student, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, katz@cmu.edu, Robert Hampshire, Alan Scheller-Wolf

We study a multiserver queue with reneging and balking. Performance indicators are shown in non-asymptotic Normal representation. We propose a revised square-root staffing rule that is applicable to a system with small resource requirement. Numerical examples show that our formulas fit well with exact solutions for entire parameter space.

3 - Analyzing a Class of No Memory Policies in Queueing Loss Models with Heterogeneous Servers

Babak Haji, PhD Student, USC, 2553 Dearborn Dr., Los Angeles, United States of America, bhaji@usc.edu, Sheldon Ross

We study a queueing loss model with heterogeneous servers with general distributions and discriminating arrivals.We analyze this system under a class of no memory assigning policies.We show that the steady state distributions are the same for all policies in this class and depend on the service distributions only trough their means.Given the set busy servers we show the remaining service times are independent and have their respective equilibrium service distributions.

■ WB19

Level 2 - Room 205C

Stochastic Models and Applications - III

Sponsor: Applied Probability

Sponsored Session

Chair: Ananth Krishnamurthy, University of Wisconsin-Madison, Madison, WI, United States of America, ananth@engr.wisc.edu

1 - FlowBalancer Supports Strategic and Tactical Planning Problems by using Analytical Queueing Models

Nico Vandaele, Professor, KU Leuven, Naamsestraat 69, Leuven, 3000, Belgium, nico.vandaele@kuleuven.be, Kris Lieckens

The design and planning of production systems at the strategic and tactical level is challenging because uncertainties make it difficult to set safety factors for three buffers: inventory, capacity and time. The FlowBalancer, developed within the SASÆ environment, adds insights from flow dynamics into the S&OP process by using advanced queueing relationships. A differential evolution algorithm can find the best combination of three buffers that improves the operational and financial performance.

2 - Optimal Server Allocation in Closed Finite Queueing Networks

J. MacGregor Smith, Professor, Dept. of Mechanical and Indust, 160 Givenors Drive, Amherst, Ma, 01003, United States of America, jmsmith@ecs.umass.edu, Ryan Barnes

Topological network design of closed finite queueing networks with finite buffers is an important part of the design and analysis of manufacturing and service systems. An effective queue decomposition methodology coupled with a nonlinear mixed integer optimization algorithm is employed to allocate servers to series, merge, and split configurations of closed network topologies.

3 - Optimal Production and Subcontracting Policies in Assemble-to-Order Systems

Ananth Krishnamurthy, University of Wisconsin-Madison, Madison, WI, United States of America, ananth@engr.wisc.edu, Ashesh Kumar Sinha

We consider an assembled-to-order manufacturing system where components required for assembly can be manufactured either in-house or by subcontracting. We use Markov decision process to evaluate tradeoffs (costs, lead times, service levels) and determine optimal production and subcontracting policies. Optimal policies are also compared with myopic policies used in practice.

4 - Toward a "Standard Model" of Supply Chain Dynamics

Mark Spearman, President, Factory Physics, Inc., 3600 E 29th Street, Bryan, TX, 77802, United States of America, spearman@factoryphysics.com

The "Standard Model" of particle physics along with the "principle of least action" forms the basis for almost all fundamental physics. Application of this principle to the supply chain naturally results in a Brownian Motion model that leads to a supply chain "uncertainty principle" relating net inventory and production. The model also provides an easy means to determine the stationary distributions of net inventory and net flow as well as suggesting new ways to control production.

■ WB20

Level 2 - Room 205D

Strategic Dynamic Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Jacob Leshno, Columbia University, New York, NY, United States of America, yarboz@gmail.com

1 - Dynamic Matching in Overloaded Systems

Jacob Leshno, Columbia University, New York, NY, United States of America, yarboz@gmail.com

We develop a model in which impatient agents with heterogeneous preferences wait for heterogeneous items. Social welfare is maximized by appropriately matching agents to items. We analyze and develop dynamic queue based assignment mechanisms which allocate items efficiently by incentivizing agents to wait for appropriate items.

2 - Performance Bounds on Optimal Fixed Prices and A New Heuristic for Dynamic Pricing

Alper Sen, Bilkent University, Dept of IE, Ankara, 06800, Turkey, alpersen@bilkent.edu.tr

We consider the problem of selling a fixed stock of items over a finite horizon. We obtain a general lower bound on the performance of using a fixed price rather than dynamically adjusting the price. The bound is 63.21% for one unit of inventory and improves as the inventory increases. For the one unit case, we also obtain tight bounds: 89.85% for the constant elasticity and 96.93% for the linear price response functions. We also suggest a new simple, near-optimal dynamic pricing heuristic.

3 - An Experimental Study of Posted Prices

Seungbeom Kim, University of Southern California, Marshall School of Business, Data Sciences and Operations, Los Angeles, CA, 90089-0809, United States of America, seungbek@usc.edu, Sriram Dasu

We use laboratory experiments to gain insights into how customers make purchase decisions when they have the option of buying at a higher price or waiting for a lower price but incur the risk of the product being out of stock. Our data does not support the rational utility maximization models commonly assumed in theoretical papers. Moreover, buyer decisions demonstrate bounded rationality. We discuss the implications that our findings hold for pricing strategies.

4 - Revenue Management in the Presence of Staying Customers

Lei Xie, Dr, Shanghai Jiao Tong University, Room 307, 1954 Hua Shan Road, Shanghai, Shanghai, China, leixie.nhb@gmail.com, Xiaoying Liang, Houmin Yan, Yimin Yu

The well-observed staying (screening-and-waiting) behavior has received little attention in revenue management. We consider two inventory models characterized by a personalized pricing and a dynamic pricing strategies, respectively. We show that the optimal selling strategy is a static multi-level protection policy. By evaluating models with/without staying customers, we report the importance of including the staying behavior in revenue management models.

■ WB21

Level 2 - Room 206

Optimization in Radiation Therapy Treatment Planning

Sponsor: Health Applications

Sponsored Session

Chair: Timothy Chan, Assistant Professor, University of Toronto, 5 Kings College Rd., Toronto, ON, Canada, tcychan@mie.utoronto.ca

Co-Chair: Taewoo Lee, University of Toronto, 5 King's College Road, Toronto, ON, M4Y3G8, Canada, taewoo.lee@utoronto.ca

1 - Robust Non-Convex Multi-Modality Radiation Planning

Omid Nohadani, Purdue University, 315 N. Grant St., West Lafayette, IN, 47907, United States of America, nohadani@purdue.edu

The radiation therapy of cancerous tumors is optimized based on initial data and independent of other modalities. When Chemotherapy is administered concurrently, the sensitivity of the tissue to radiation changes over time, reducing the treatment quality. A robust non-convex optimization method is proposed, harnessing this evolution and provides strategies that are intrinsically insensitive to deviations from the assumed temporal path. Clinical cases are used to demonstrate the performance.

2 - Stepwise Inverse Optimization for IMRT Treatment Plan Optimization

Daria Terekhov, Mechanical and Industrial Engineering, University of Toronto, 5 King's College Road, Toronto, ON, M5S3G8, Canada, dterekho@mie.utoronto.ca, Taewoo Lee, Timothy Chan

Following an analogy between regression and inverse optimization, this work introduces a framework for stepwise inverse optimization and demonstrates its usefulness for IMRT optimization. Specifically, given a clinical treatment plan, our framework provides a structured approach to determining the set of objective functions that are most influential for treatment plan optimization and their weights.

3 - A New Voxel-based Optimization Algorithm for Automatic Planning, Re-planning and Interactive Treatment

Masoud Zarepisheh, University of California-San Diego, San Diego, CA, United States of America, mzarepisheh@ucsd.edu, Nan Li, Xun Jia, Feng Shi, steve jiang

The conventional treatment planning procedure is a time-consuming task that may need multiple iterations between the dosimetrists and clinicians. We develop a new algorithm to adjust the voxel weighting factors and reference doses automatically to navigate on the Pareto surface to find out a plan with a desirable DVH or dose distribution. The applications of the algorithm in automatic treatment planning, adaptive radiotherapy re-planning and interactive treatment planning would be presented.

4 - Ventilation Map Based Radiotherapy for Locally Advanced Lung Cancer with Motion Management

Hamid Ghaffari, Postdoctoral Fellow, University of Maryland, 22 S Greene, Baltimore, United States of America, ghaffari@mie.utoronto.ca

We propose a radiotherapy optimization method for lung cancer by considering organ motion as well as the organ function. We used probability function masses to present organ motion uncertainty while utilizing the personalized utility function in the optimization objective during radiation treatment planning. Although the plans were comparable with conventional dose/dose-volume metrics, reductions of 25% and 38% in fV20 and fV30, respectively, were achieved by FPMF-based plan (p-value < 0.01).

■ WB22

Level 2 - Room 207

Health Care III: Scheduling I

Contributed Session

Chair: Asli Ozen, PhD candidate, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, 01003, United States of America, aslozen@gmail.com

1 - An Abdominal Surgery Scheduling Problem Considering Patient Condition

Joonyup Eun, Purdue Univeristy, 315 N. Grant Street, West Lafayette, IN, 47907-2023, United States of America, eunj@purdue.edu, Yuehwern Yih

This research describes an operating room planning problem in which patients with different conditions are scheduled for elective abdominal surgery. The problem deals with abdominal diseases which not only exacerbate patient condition with the lapse of waiting time, but also have different severity when they are diagnosed. A stochastic programming model is proposed to prevent the worst condition of patients.

2 - A Harmony Search Approach for Integrating Anesthesia Nurse and Trainee Scheduling in the Operating

Ming Lv, Ph.D candidate, Xi'an Jiao Tong University, West Xian Ning Rd. 28#, Xi'an, Xi'an, China, sharplvming@qq.com, Zhili Zhou

A common problem at operating room is that there is a variation of daily workload pressure for staffs. According to old scheduling method, after a period of time, each person's work time could be varying in a huge number. First of all, we present a concrete model that integer both nurse and trainees who work at operating room. Second, we show how the hybrid harmony search algorithm solves this problem. Third, we use a larger number of data to test this algorithm's effectiveness and efficiency.

3 - Optimizing Spine Surgery Scheduling

Asli Ozen, PhD candidate, University of Massachusetts - Amherst, 160 Governors Drive, Amherst, MA, 01003, United States of America, aslozen@gmail.com, Hari Balasubramanian, Jeanne Huddleston, Paul Huddleston, Narges Hosseini, Yariv Marmor

We discuss a case study from Mayo Clinic orthopedic spine surgery practice focused on increasing patient access to spine surgeries and improving financial performance while promoting better quality of life for surgical staff. This was done by increasing surgery time predictability, optimizing patient mix and scheduling, and building an interactive web-based scheduling application making use of the optimized scheduling approach.

■ WB23

Level 2 - Room 208A

Topics in Retail

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ronald Menich, EVP & Chief Scientist, Predictix, Two Midtown Plaza; Suite 1880, 1349 W. Peachtree Street NW, Atlanta, GA, 30309, United States of America, Ronald.Menich@predictix.com

1 - Impacts of Supply Chain Power Structure on Retail Selling Prices and Consumer Surplus

Ozgun Demirag, Penn State Erie, The Behrend College, 5101 Jordan Road Burke 259, Erie, PA, 16563, United States of America, ozc1@psu.edu, Weili Xue, Baozhuang Niu

We investigate the impacts channel power structures on alternative retail pricing strategies and consumer surplus. We find that the manufacturer-dominated channel leads to lowest retail price and largest expected surplus for an individual customer; however, entire channel profit and total consumer surplus are highest when the retailer holds channel dominance.

2 - An Integrated Framework for Forecasting, Markdown and Replenishment Optimization

Ulas Cakmak, Senior Scientist, Predictix, 1349 W. Peachtree Street NW, Atlanta, GA, 30309, United States of America, ulas.cakmak@predictix.com, Emir Pasalic, Mokhtar Bazaraa, Zografoula Vagena

We discuss analytical and estimation challenges in Forecasting, Markdown and Replenishment Optimization in a retail environment. Different aspects of these problems and interactions between them are analyzed. A Cloud based solution implementation, where parallel processing allows us to solve complex optimization models, is presented.

3 - Managing Perishable Inventories in Retailing: Replenishment, Clearance Sales, and Segregation

Peiwen Yu, Ph.D. Candidate, Hong Kong Univ of Science and Technology, ISOM Department, HKUST, Clear Water Bay, Hong Kong, Hong Kong - PRC, freeypw@ust.hk, Qing Li

We study joint replenishment and clearance sales of perishable goods under a general finite lifetime and a last-in-first-out (LIFO) issuing rule, a problem common in retailing. We show the structure of the optimal policy and propose simple myopic heuristics that require only partial age information.

■ WB24

Level 2 - Room 208B

Issues in Assortment Retailing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Sri Devi Duvvuri, Asst. Professor, SUNY at Buffalo, 215 Jacobs, Buffalo, NY, 14260, United States of America, sduvvuri@buffalo.edu

1 - Multichannel Buying; Investigating Channel Choice for Heterogeneous Goods

Richard Briesch, Associate Professor of Marketing, School of Business, Southern Methodist University, Dallas, TX, 75275, United States of America, rbriesch@mail.cox.smu.edu, Jaquelyn Thomas, Sandy Jap

Multichannel research has primarily focused on individual consumers purchasing homogenous products across multiple channel formats. This research investigates multichannel purchasing in markets for heterogeneous goods – the product's value and the purchase decision are dependent upon its physical condition and the assortment of goods offered. We examine whether it is possible that a channel could offer too much (little) assortment or products that are in too pristine (poor) physical condition?

2 - Where Multi-store Shoppers Buy: Theory and Empirical Evidence

William R. Dillon, Southern Methodist University, Dallas, TX, United States of America, bdillon@cox.smu.edu, Edward J. Fox, John Semple

Recent research and industry trends highlight the growing impact of multi-store shopping on retailer revenues and profits. This research considers where multi-store shoppers purchase the items on their shopping lists; specifically, the "common items" that are available at competing stores. Multi-store shoppers purchase some common items at the first store they visit; other common item purchases are deferred to a competing store. These purchase decisions depend on the prices observed at the first store and the uncertainty about saving money by deferring purchase to a competing store. We introduce an analytical model of where multi-store shoppers purchase the common items on their shopping lists that extends the optimal search literature in some important ways: 1) it assumes that multi-store shoppers visit a fixed number of stores—two—rather than searching sequentially without time constraints; 2) it assumes "no recall;" 3) it allows prices at the two stores to have different price distributions; and 4) of particular interest, it generalizes the cost minimization objective function commonly used in optimal price search to include psychological benefits from saving money. Analysis of this model shows that, for multi-store shoppers who enjoy psychological benefits from saving money (PB shoppers), the ratio of expected price savings to the variance in price savings drives their purchase decisions.

3 - Effects of Product Architecture on Market Segmentation and Pricing Strategies

Weiyan Liu, School of Management Xi'an Jiaotong University, No.28 XianNing West Road, Xi'an ShanXi, 710049, China, 2567090358@qq.com, Qin Su

We consider the impact of product architecture on pricing strategies of a monopoly and his suppliers where the monopoly's product line includes two substitutes which are different in product architecture .We analyze the differences of market shares when the monopoly buys components separately or modules as a whole from the suppliers. We find that the product architecture has such a significant effect that higher profit is actually realized at the sacrifice of one substitute's market share.

4 - Product Assortment Competition with the Decoy Effect

Anton Kleywegt, Associate Professor, ISyE - Georgia Tech, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, anton@isye.gatech.edu, Xinchang Wang

Consider setting A with a low-profit product and a high-profit product, and setting B with these same products as well as an apparently irrelevant product that is clearly inferior to the high-profit product. It has been widely observed that a larger fraction of people choose the high-profit product in setting B than setting A. This is the decoy effect. We study product assortment competition in a duopoly with decoys among candidate products. We characterize the Nash equilibria, and use dynamical systems models to study the evolution of the competition and the stability of the equilibria.

5 - An Analysis of Assortment Choice in Grocery Retailing

Sri Devi Duvvuri, Asst. Professor, SUNY at Buffalo, 215 Jacobs, Buffalo, NY, 14260, United States of America, sduvvuri@buffalo.edu, Kyuseop Kwak, Gary Russell

Consumers in grocery retailing commonly buy bundles of products to accommodate current and future consumption. The model, a new specification of the multivariate logistic market basket model, is based upon the assumption that the utility of purchase of one item in an assortment depends upon the set of items already selected. We show that product choice is affected by brand-quality perceptions and that reaction to reductions in variety in the category is mediated by brand quality perceptions.

■ WB26

Level 2 - Room 208D

GIS and Spatial Analysis

Contributed Session

Chair: Fe de la Cruz, Caraga State University, Brgy. Ampayon, Butuan City, Philippines, fe_dela_cruz@yahoo.com

1 - Highway Patrol Planning and Needs Assessment using GIS

Poyraz Kayabas, Research Assistant, North Dakota State University, 323 LLC East, PO Box 5474, North Dakota State University, FARGO, ND, 58105, United States of America, poyraz.kayabas@ndsu.edu

Geographical Information System (GIS) tools can be used for diverse tasks in patrol planning and needs assessment. GIS tools also utilize the use of available data resources, such as geospatial road network data and traffic crash data, to predict realistic performance measures for patrolling operations. In this study, GIS-based vehicle routing model will be developed and used for patrol routing.

2 - Algorithms for Solving Complementary Median and Center Facility Location Problems

Christopher Rump, Associate Professor, Bowling Green State Univ, Applied Statistics & Operations Research, College of Business Administration, Bowling Green, OH, 43403, United States of America, cmrump@bgsu.edu

We consider complements to the classic median and center facility location problems on a discrete network of potential facility sites and customer demands. These complementary problems are able to provide alternative solutions for decision makers seeking to consider the impact beyond extremal focus on either one (center) or all (median) constituents. We outline Lagrangian relaxation algorithms for solving these more computationally demanding integer programming problems.

3 - Multidimensional Coalition Formation Models: The Impact of Distance Selection and Issue Saliences

Tom Blockmans, Vrije Universiteit Brussel, Pleinlaan 2, Brussels, 1050, Belgium, tblockma@vub.ac.be, Frank Plastria

We examine two important, but often forgotten, aspects of spatial coalition formation. Distance selection refers to the choice between (squared) Euclidean and rectangular distance functions to express the difference in policy positions. Issue saliences incorporate the policy priorities of the parties involved in the coalition. An empirical application of 28 OECD democracies illustrates the impact that both aspects have on the predictive power of four spatial models.

■ WB27

Level 2 - Room 209A

Inventory Management: Retail and Delivery

Contributed Session

Chair: Vincent Slaugh, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15208, United States of America, vslaugh@cmu.edu

1 - A Threshold Inventory Rationing Policy for Omni-Channel Retailer

Elnaz Jalilipour Alishah, University of Washington, Box 353200, Foster School of Business, UW, Seattle, WA, 98195-3200, United States of America, jalilipo@uw.edu, Kamran Moinzadeh, Yong-Pin Zhou

We study inventory rationing policy for an omnichannel retailer, where store inventory is used to satisfy online demand after stock out. From an economic perspective, it may be better for demand to be lost even if the other channel has inventory. We investigate optimal stocking policy and find the set of times where online demand is lost if store inventory is less than optimal threshold. For practically purpose we develop simple and good heuristics to facilitate implementation.

2 - Managing a Rental System with Random Inventory Loss

Vincent Slaugh, Carnegie Mellon University, Tepper School of Business, Pittsburgh, PA, 15208, United States of America, vslaugh@cmu.edu, Sridhar Tayur, Bahar Biller

Motivated by a high-fashion dress rental business, we formulate a discrete-time stochastic inventory model with rentals. For a system with lost sales and arbitrary demand, we demonstrate structural properties of a system with random inventory loss and random rental duration, and show how to solve the problem using simulation optimization methods. We conclude with managerial insights about pricing and the impact of inventory loss on rental inventory management.

3 - Designing Optimal Dimensions for Multi-deep Racks under Random and Class-based Storage Policies

zou bipan, Huazhong university of science and technology, luoyu road 1037, wuhan, 430074, China, zbp0307@126.com, Xianhao Xu

We have studied a multi-deep storage and retrieval system whose S/R machine is constructed by a lift and a vehicle with the vehicle moving into the rack to pick pallets. The travel-time models of S/R machine we formulate under three different policies are all nonlinear integer programming problems which we can hardly obtain analytical solution, however, we have shown how to obtain the optimized dimensions with given rack capacity and storage parameters.

4 - The Value of Depression Concerns When Selling to Heterogeneous Customers

Yugang Yu, University of Science & Technology of China, No. 96, Jinzhai Road, Hefei, China, ygyu@ustc.edu.cn, Junfei Lei

This paper incorporates depression concerns into market where customers are heterogeneous by loyalty level to two retailers. Which retailer gains more profit is conditional in benchmark. Two strategies, publicity and compensation, are proposed to improve retailers' profits. Results show that publicity guidance is necessary and retailers give different priorities in compensation

■ WB28

Level 2 - Room 209B

Simulation

Contributed Session

Chair: Ali Mostafavi, Assistant Professor, Florida International University, 10555 West Flagler St. Engineering Cente, Miami, FL, 33174, United States of America, almostaf@fiu.edu

1 - Exact Simulation of Periodic Brownian Queue

Mohammad Mousavi, Stanford University, 140 Ayrshire Farm Lane#103, Stanford, CT, 94305, United States of America, mousavi@stanford.edu, Peter Glynn

In this work, we provide a method for the exact simulation of reflected Brownian motion (RBM) with non-stationary drift and infinitesimal variance. RBM is commonly used as a stylized representation of a single-station queue. In many real-world applications of queuing models, there exist non-stationaries in the arrival rates and/or service time. This method provides an exact sampling method of non-stationary RBM and can be used to plan simulations of queuing models with non-stationary inputs.

2 - Functional Relationship Variables in Discrete Event Simulation

Stephen Peterson, Instructor, Texas Tech University, Industrial Engineering, Mail Stop 3061, Lubbock, TX, 79409, United States of America, stephen.peterson@ttu.edu, Milton Smith

Implementation of functional relationships in Discrete Event Simulation (DES) through MATLAB in ARENA depends on and is most easily used when system variables are represented by common probability distributions. Real world systems may have variables that are functionally related to system state variables or external variables. MATLAB modeling of these variables can adequately model these relationships.

3 - A Framework for Policy Simulation in Complex Infrastructure Systems

Ali Mostafavi, Assistant Professor, Florida International University, 10555 West Flagler St. Engineering Cente, Miami, FL, 33174, United States of America, almostaf@fiu.edu, Dulcy Abraham

A hybrid Agent-Based/System Dynamics framework is created to simulate the micro-behaviors of players and the uncertainties in the realm of policies for financing highway transportation infrastructure. This framework is used along with meta-modeling to simulate the policy landscape of highway transportation financing and to explore the highly likely scenarios for closing the financing gap in the U.S. highway infrastructure.

■ WB29

Level 2 - Room 210A

Firm Performance and Valuation

Contributed Session

Chair: Sung Hak Kim, KAIST, Dongdaemungu Hueigiro 85, Seoul, Korea, Republic of, giveallu@business.kaist.ac.kr

1 - Social Impact of Business Model: Evidence from India

Rakesh Pati, Carlson School of Management, 595 Sherburne Avenue, Saint Paul, MN, 55103, United States of America, rkpati7@gmail.com

Business Model helps the organizations create and capture values. Using data from Indian SMEs, this study found that business model innovation and efficiency significantly influence their social performance. The findings of the study extends the importance of business models for social performance of the firm. Moreover, the study adds to the limited empirical studies on social impact of Indian firms.

2 - Mobility and the Development of Firm Capabilities in the U.S. Laser Industry

Erin Fahrenkopf, PhD Student, Carnegie Mellon University, 333 Morewood Ave., 7, Pittsburgh, PA, 15213, United States of America, emckinne@andrew.cmu.edu

I join insights on capabilities and knowledge transfer by interfirm mobility to examine if individuals with market experience contribute to a firm's likelihood of entering the market and test this in the laser industry. I find support that hiring those with market experience increases a firm's chance of market entry and how diffuse these movements are impacts the level of market entry. Findings improve understanding of the links between capability development, mobility, and industry evolution.

3 - Determinants of R&D and the Relationship between R&D Characteristics and Firm Performance

Sung Hak Kim, KAIST, Dongdaemungu Hueigiro 85, Seoul, Korea, Republic of, giveallu@business.kaist.ac.kr, Bowon Kim

We examine how the organization and R&D input affect R&D characteristics (newness, imitability) and R&D activity (external collaboration). And the relationship between R&D characteristics and firm performance will be explored. Using the survey data from 3400 small- and medium-sized enterprises in Korea, we conduct path analysis to prove the hypotheses. We find the organizational and firm resource factors which affect R&D characteristics and firm performance.

■ WB30

Level 2 - Room 210B

Heuristic Optimization Applications

Contributed Session

Chair: Utku Koc, Northwestern University, 2165 Sheridan Rd., Evanston, IL, 60202, United States of America, utkukoc@northwestern.edu

1 - A Heuristic Approach for Well Placement Optimization in Gas Reservoirs

Ehsan Jafari Shirazi, PhD candidate, West Virginia University, 2441 District Dr., Morgantown, WV, 26505, United States of America, ejafaris@mix.wvu.edu, Mehrdad Shahabi

Most of the works have been done in literature for well placement optimization employ a reservoir simulator to estimate the objective function combining with modern soft computing techniques such as GA. However, they all come with this drawback of being expensive in terms of CPU time. In this study, an appropriate model for gas reservoirs case is proposed, and a heuristic approach for solving the model is investigated.

2 - Sequence Scheduling with Batching Coordination in a Manufacturing Supply Chain

Li Jie, Xi'anJiaoTong University, Xi'an, Shaanxi Province, Xi'an, China, neustar2010@sina.com, Liang Qiaozhuan, Li GenQiang

This paper considers a manufacturing supply chain scheduling problem in which a supplier releases jobs to one manufacturer. Each job demands different amount of storage space during delivery. We schedule the batching and producing sequences in both machines of supplier and manufacturer to minimize makespan. A mathematic model is formulated and then a heuristic approach based on genetic algorithm is presented. Instances of different scales demonstrate the practical implications of our work.

3 - Two-stage Stochastic View Selection for Data-analysis Queries: Properties and Algorithms

Rong Huang, Sr Associate Analytics Software Tester, SAS Institute Inc., 100 SAS Campus Drive, Cary, NC, 27513, United States of America, rong.huang@sas.com, Yahya Fathi, Rada Chirkova

We consider the problem of selecting views in a data-analysis system and propose a new paradigm to study this problem in a two-stage probabilistic environment. We present a stochastic programming model and an equivalent integer programming model. We define the cost-benefit ratio of each view which is a measure of effectiveness of the view, and employ this concept to develop exact and inexact methods for solving large instances of the problem.

4 - Heuristically Generating Integer Solutions in Parallel for Unstructured Mixed Integer Programs

Utku Koc, Northwestern University, 2165 Sheridan Rd., Evanston, IL, 60202, United States of America, utkukoc@northwestern.edu, Sanjay Mehrotra

We describe an approach to parallelize generation of feasible solutions of mixed integer programs. The approach combines feasibility pump (FP) with randomization. The proposed approach runs multiple FP instances with different objective functions, in parallel. Our results suggest that, running multiple instances with original, perturbed and random objective functions improve the overall quality of the solutions generated.

■ WB31

Level 2 - Room 211A

Quantitative Financial Risk Management

Sponsor: Financial Services

Sponsored Session

Chair: Bo Zhang, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, NY, 10598, United States of America, bozhang@gatech.edu

1 - Robust Dynamic Hedging

Zhenming Liu, Princeton University, 35 Olden street, Princeton, NJ, 08540, United States of America, zhenming@princeton.edu, Henry Lam

We consider a robust approach to the dynamic hedging of options by modeling the market as a repeated game between the nature and the investor. Based on a simple LP, we show the equivalence of the game to the binomial tree model when the option payoff is convex. For non-convex payoffs, the problem is in general #P-hard, and we design provably efficient approximation algorithm. We also consider the extension of our framework to markets with rare-event jump behavior.

2 - Bilateral Credit Valuation Adjustment for Large Credit Derivatives Portfolios

Agostino Capponi, Johns Hopkins University, Baltimore, MD, United States of America, acappon1@jhu.edu

We obtain an explicit formula for the CVA adjustment of a credit default swaps portfolio referencing an asymptotically large number of entities. The key insight behind our approach is an explicit characterization of the portfolio exposure as the weak limit of measure-valued processes associated to survival indicators of portfolio names. We numerically show that CVA is highly sensitive to portfolio credit risk volatility as well as to default correlation.

3 - Intensity-Based Models of the Credit Value Adjustment: Capturing Wrong Way Risk

Samim Ghamami, University of California-Berkeley, Berkeley, CA, United States of America, samim_ghamami@berkeley.edu

Hull and White (2013) model wrong way risk in Credit Value Adjustment calculations by expressing the counterparty's default intensity in terms of the financial institution's credit exposure. We derive a formula for CVA for a similar class of intensity models; we show that wrong way risk does not affect the credit quality of the counterparty. Our numerical examples demonstrate that independent CVA can exceed wrong way CVA.

■ WB32

Level 2 - Room 211B

Emergent Innovation and Value Creation in Product-Service Systems (PSS)

Sponsor: Technology Management

Sponsored Session

Chair: James Hazy, Visiting Professor, Malardalens University, Eskilstuna, Sweden, hazy@adelphi.edu

1 - Using Customer Interactions for Product and Service Innovation in a Telecom Context

Athanasios Karapantelakis, Research Engineer, Ericsson, Farogatan 6, Stockholm, 16440, Sweden, athanasios.karapantelakis@ericsson.com

In order to adapt to a transforming telecom industry driven by technological evolution, network providers need to leverage their relationship with customers through personalized offerings. We present a conceptual model describing how customer interactions foster innovation in a telecom context. This framework will identify the different ways customer interactions can facilitate creation of new offerings and will include a number of case studies showing how the model can be used in reality.

2 - Emergent Innovation – Towards as New Paradigm for Innovation Research and Management

Erik Lindhult, M‰lardalen University, Box 325, Eskilstuna, SE 63105, Sweden, erik.lindhult@mdh.se

Emergent innovation describes value creation as something that can emerge everywhere, and wherein anyone can become an innovator. It assumes that innovation can only partly be formalized in processes, concentrated in specific units, and performed in a planned fashion by innovation experts. This paper argues that the ways in which human interaction dynamics generate emergent innovative structures can be clarified using complex systems models that include nonlinear interactions and processes.

3 - Business Model Innovation in the Cloud

Christer Nygren, M%lardalen University, Box 325, Eskilstuna, SE 63105, Sweden, christer.nygren@mdh.se, Catharina Limmerfelt, Erik Lindhult, Anders Kettis

Information and communication technology (ICT) and cloud data change the way innovation occurs in traditional industrial companies. This paper presents a case study in the development of a web platform for enabling service innovation and increased customer interaction in a global industrial company, ABB. It describes a model for how an ICT platform, enables new service oriented business model innovation, increasing value creation for customers and new ways for capturing of value for the company.

4 - Generative Leadership Practices and Value Identification

James Hazy, Visiting Professor, Malardalens University, Eskilstuna, Sweden, hazy@adelphi.edu, Tom Shinick

The paper explores specific and differentiated leadership practices that lead to the identification of value creation opportunities. It argues that value identification places two functional demands on organizations which are enacted by leadership: information gathering enables situational awareness and generative activities create relevant information to be recognized and interpreted. A complexity-informed model of these functions is offered and preliminary empirical support is described.

■ WB34

Level 2 - Room 211D

Overcoming the Challenge of Input Uncertainty

Sponsor: Simulation Society

Sponsored Session

Chair: Canan Gunes Corlu, Assistant Professor, Boston University, 808 Commonwealth Avenue, Boston, United States of America, canan@bu.edu

Co-Chair: Bahar Biller, Associate Professor, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Posner Hall 360, Pittsburgh, PA, 15213, United States of America, billerb@andrew.cmu.edu

1 - Statistical Uncertainty Analysis for Stochastic Simulation

Wei Xie, Northwestern University, 2145 sheridan Rd. c210, evanston, Il, 60208, United States of America, weixie2013@u.northwestern.edu, Barry Nelson, Russell Barton

When we use simulation to evaluate the performance of a stochastic system, the input models are often estimated from real-world data. We derive a confidence interval that accounts for both simulation and input-model uncertainty by using a metamodel-assisted bootstrapping approach. Our approach is rigorously supported with both theoretical analysis and an empirical study.

2 - Accounting for Parameter Uncertainty in Subset Selection for Simulation

Canan Gunes Corlu, Assistant Professor, Boston University, 808 Commonwealth Avenue, Boston, United States of America, canan@bu.edu, Bahar Biller

We study the subset selection procedure for simulation when the parameters of the input distributions are unknown. Redesigning the subset-selection procedure to account for parameter uncertainty, we provide insights into the effect of parameter uncertainty on the performance of subset-selection procedure. We conclude with an illustration of our approach in multi-item inventory control.

3 - Data-driven Newsvendor with Temporally Dependent Demand

Alp Akcay, Bilkent University, Ankara, Turkey, aakcay@andrew.cmu.edu, Bahar Biller, Sridhar Tayur

Considering a newsvendor problem with temporally dependent demand data, we characterize a probabilistic guarantee for the expected cost of an inventory-target estimate to be close to the optimal expected cost with an arbitrarily small relative error. Our analysis sheds light on the role of temporal dependence in inventory-target estimation.

4 - Benefit of Capacity Pooling in Second-Production-Opportunity with Random Yields

Saurabh Bansal, Pennsylvania State University, 405 Business Building, University Park, PA, United States of America, sub32@psu.edu

We model seed corn supply chain where a firm has two opportunities to produce seed corn before observing the demand. The capacity for the second production opportunity must be determined in advance. We discuss algorithms to determine the optimal reservation amount given the possibility of using the same capacity to produce multiple varieties of seed corn.

■ WB35

Level 2 - Room 212A

Applications of Network Optimization

Contributed Session

Chair: Onur Seref, Virginia Polytechnic Institute and State University, 2060 Pamplin Hall (0235), Blacksburg, VA, 24061, United States of America, seref@vt.edu

1 - Determining the Number of Paths and Network Complexity Index in Activity Networks

Bajis Dodin, Professor, University of California, School of Business Administration, UCR, Riverside, CA, 92521, United States of America, bajis.dodin@ucr.edu, A. A. Elimam

Activity networks (AN) are acyclic directed project networks. The effectiveness of the analysis and optimization of AN could be enhanced by the determination of the number of paths and/or the complexity index of such networks. In this paper, we develop procedures to calculate the number of AN paths and its complexity index in a linear order of the number of nodes in an Activity-on-Arc project network. Computational work is provided to illustrate the proposed approaches and their benefits.

2 - An Efficient Algorithm to Match GPS Data on a Map

Renaud Chicoisne, PhD Student, Universidad de Chile, Vergara 559, Santiago, RM, 8320000, Chile, renaud.chicoisne@gmail.com, Daniel Espinoza, Fernando Ordonez

Estimating the distribution of travel times on a transportation network from vehicle GPS data requires finding the closest path on the network to a trajectory of GPS points many times. In this work we develop an efficient algorithm to find such a path and use heuristic steps to accelerate this algorithm in practice. We present computational results comparing these algorithms for over 30000 real and generated GPS samples on a grid graph and real maps of the cities of Seattle and Santiago.

3 - Aircraft Dispatching Strategy

Massoud Bazargan, Professor & Dept. Chair, Embry-Riddle Aeronautical University, 600 S. Clyde - Morris Blvd., Daytona Beach, 32114, United States of America, bazargam@erau.edu

This paper presents a new large scale integer programming model to identify the aircraft dispatching strategy so that the total cost of scheduled maintenance is minimized.

4 - Decomposition of Flux Distributions into Metabolic Pathways using Hypergraphs

Onur Seref, Virginia Polytechnic Institute and State University, 2060 Pamplin Hall (0235), Blacksburg, VA, 24061, United States of America, seref@vt.edu, J. Paul Brooks

In this study, we develop a novel computational method for analyzing predicted flux distributions for metabolic reconstructions using generalized flows on hypergraphs. We demonstrate that the generalized hyperflow problem may be transformed to an equivalent network flow problem with side constraints. This transformation allows a flux to be decomposed into chains of reactions. The proposed method is applied to study changes in a metabolism during a space flight.

5 - Topological Optimization on Artificial Neural Network with Application to Financial Data Forecasting

Shiye He, London School of Economics and Political Science, Houghton Street, London, WC2A 2AE, United Kingdom, s.he3@lse.ac.uk

The research develops a new heuristic method for optimizing the structure of topology from a complete feed-forward Artificial Neural Network (ANN) in an aim to improve its performance by reaching a near-global optimal state. The application is applied to forecasting equity index S&P500 using selected 19 financial indicators. Preliminary result shows the application simplifies the topology of ANN, improving out-of-sample performance on RMS comparing to the original complete ANN.

■ WB36

Level 2 - Room 212B

Health Care VIII: Inventory and Supply Chain

Contributed Session

Chair: Raja Jayaraman, Assistant Professor, Industrial & Systems Engineering, Khalifa University, P O Box 127788, Abu Dhabi, United Arab Emirates, raja.jayaraman@kustar.ac.ae

1 - Improving Blood Supply Management: Donation Tailoring and Inventory Management

Guven Kaya, Ph.D. Student, University of Houston, Department of Industrial Engineering, 4800 Calhoun Road, Houston, TX, 77004, United States of America, gkaya@central.uh.edu, Ali Ekici

Blood donation tailoring is to identify blood donation types and collect blood products. Donors perform donation types that provide blood products to patients, having collection costs of donation types and inventory and spoilage costs of products. We collect data about donation types and products with demand, cost, time, eligibility percentages, compatibility from blood banks. We develop MIP models to find collected/spoiled/carried blood product amount on single and multi-period settings.

2 - Optimization and Quantitative Analysis of Kidney Allocation Policy

Philip Appiah-Kubi, PhD. Candidate, Ohio University, 533 Landover PL, Gahanna, OH, 43230, United States of America, pa809911@ohio.edu, Park Namkyu

The kidney allocation policy has evolved from tissue matching to waiting time. Although the demand for kidney far exceeds donated kidneys, thousands of these potentially good resources are discarded yearly while candidates wait an average of 4 to 5 years for transplantation with some dying on the waiting list. This research will integrate utilization factor into the kidney allocation policy and will utilize optimization and quantitative analysis to review the kidney allocation policy.

3 - Liver and Multi-Organ Exchange

John Dickerson, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15232, United States of America, dickerson@cs.cmu.edu, Tuomas Sandholm

We consider extending organ exchange to liver lobes. We implement a general organ exchange compatibility graph generator; it addresses weaknesses in the standard kidney exchange generator. We show liver exchange clearing results on this demographically accurate data, and optimally clear liver exchanges at the estimated nationwide size using an enhancement to the fielded kidney exchange clearing algorithm. We explore cross-organ donation and show that this increases total number of lives saved.

4 - Challenges and Opportunities in Global Healthcare Supply Chains

Raja Jayaraman, Assistant Professor, Industrial & Systems Engineering, Khalifa University, P O Box 127788, Abu Dhabi, United Arab Emirates, raja.jayaraman@kustar.ac.ae

Over 40% of the overall spend in healthcare industry is related to supply chain activities, which presents significant driver for process improvements and cost savings opportunities. In this talk we shall present some of the global challenges in the healthcare supply chains and directions for improvements to streamline operations to improve supply chain reliability.

■ WB37

Level 2 - Room 213A

Project Management

Contributed Session

Chair: Christina Schmalz, Deutsche Post Chair of Optimization of Distribution Networks RWTH Aachen University, Kackertstr. 7, Aachen, 52072, Germany, schmalz@or.rwth-aachen.de

1 - Investment Allocation among Alliance Members: An Approach Based on Cooperative Game Theory

Ying Gao, Tianjin University, Room A616, Building #25 Tianjin University, Weijin Road #92, Tianjin, 300072, China, ygao@tju.edu.cn, Zhuo Feng, Shui-Bo Zhang

Investment allocation is important for the stability of the alliance: the required investment for a party being below her expected level (thus lower benefits afterwards) or being beyond her budget will both lead to her exit. In this paper, we suggest some possible allocation solutions based on cooperative game theory when the optimal investment level is determined ex ante and when it is not. We prove that the solutions equal the nucleoli of the corresponding coalitional games.

2 - Economic Production Quantity with Imperfect Quality and Energy Price

Farnaz Ghazi Nezami, Wichita State University, 1845 Fairmount St., Wichita, KS, 67260, United States of America, farnaz.ghazinezami@wichita.edu, Mehmet Bayram Yildirim

In classic Economic Production Quantity (EPQ) model, unit production cost, setup cost and production rate are fixed and the production process is of perfect quality. We assume an imperfect EPQ model where a percentage of the produced parts is defective and some rework is required on these items. We develop a mathematical model to minimize the overall cost of this system with energy price, rework cost, and determine the optimum production run length, and the associated production rate.

3 - Improving the Productivity of Service Provision: The Resource-Constrained Service Scheduling Problem

Christina Schmalz, Deutsche Post Chair of Optimization of Distribution Networks RWTH Aachen University, Kackertstr. 7, Aachen, 52072, Germany, schmalz@or.rwth-aachen.de

Service planning is a crucial key factor for the success of companies. We have developed a mixed integer problem (MIP) to improve the productivity of service provision. We have extended our model – which we call RCSSP and which is based on the RCPSP – to include influencing factors of services. The MIP accounts for activity preemption and overlapping, heterogeneous skills, customer influence, and rework and communication effort. Our model minimizes the costs and duration of a project.

■ WB38

Level 2 - Room 213B

Topics in Supply Chain Management II

Contributed Session

Chair: Dean Chatfield, Associate Professor, Old Dominion University, 2063 Constant Hall, IT/DS Dept. - College of Business, Norfolk, VA, 23529, United States of America, dchatfie@odu.edu

1 - Integrated Tertiary Educational Supply Chain Management (ITESCM) Model

Mamun Habib, Assistant Professor, American International University - Bangladesh (AIUB), House No. 7, Road No. 8, Block - F, Banasree, Rampura, Dhaka, 1219, Bangladesh, mamunhabib@gmail.com

This exploratory study addresses education supply chain, research supply chain, and educational management as major constituents in Integrated Tertiary Educational Supply Chain Management (ITESCM) model.ITESCM model furnishes stakeholders of the supply chain with appropriate strategies to review and appraise their performance toward fulfillment of ultimate goals for the betterment of the society.

2 - Considering Marginal Value of Time and Product Residual Value in Designing a Reverse Logistic System

Che-Wei Yeh, Student, National Taiwan University, Floor 9, No.1, Sec. 4, Roosevelt Road, Taipei, Taiwan - ROC, d99741008@ntu.edu.tw, David Ming-Huan Chiang

Previous studies showed returned products lost 45% of its value in the reverse logistics chain, causing unnecessary loss of resources. Thus, by adopting Preponement system becomes an important issue. This study examines the effect designing a reverse chain by considering MVT and PRV. Our result shows with high MVT and PRV product in certain situations, Preponement is proved to be economically beneficial. This study provides suggestions to the company regard Preponement to enhance value recovery.

3 - Return Policies and the Bullwhip Effect

Dean Chatfield, Associate Professor, Old Dominion University, 2063 Constant Hall, IT/DS Dept. - College of Business, Norfolk, VA, 23529, United States of America, dchatfie@odu.edu, Alan Pritchard

Allowing the unrestricted return of excess goods is a common assumption in the bullwhip effect literature. We build a hybrid agent/discrete-event simulation of a multi-stage supply chain and execute it under various conditions to ascertain the impact of returns on the bullwhip. We find permitting returns significantly increases the bullwhip effect and models that assume returns are permitted will systematically overestimate the bullwhip effect for supply chains that restrict returns.

■ WB41

Level 1 -101A

Supply Chain Networks

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Kostas Bimpikis, Stanford University, 655 Knight Way, Knight Management Center, E-360, Stanford, CA, 94305, United States of America, kostasb@gsb.stanford.edu

1 - Buyer-Supplier Relationships in Global Sourcing Networks

Elena Belavina, Assistant Professor, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60611, United States of America, Elena.Belavina@chicagobooth.edu, Karan Girotra

We study general bipartite buyer-supplier networks, where buyer demand and supplier supply are uncertain. We identify network structures that are most amenable to establish relational equilibria in sourcing transactions. Our results illustrate challenge a number of widely held beliefs on supplier management strategies, for instance considering the network structure shows that wider supplier bases may be inimical to buyers.

2 - Correlated Disruption Risk in Supply Networks

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, 418 Uris Hall, New York, NY, 10023, United States of America, alirezat@columbia.edu, Kostas Bimpikis, Douglas Fearing

This paper shows how in the presence of incomplete contracts, dual sourcing by a firm's suppliers may reduce its profits. It also shows how divergence between the retailer's and its suppliers' sourcing incentives can reduce overall welfare and lead to ineffiently fragile supply chains.

3 - Why do Sellers Share Aggregate Inventory Information with Customers?

Hyoduk Shin, UC San Diego Rady School of Management, 9500 Gilman Drive, La Jolla, CA, 92093, United States of America, hshin@rady.ucsd.edu, Ruomeng Cui

We study why a retailer may share the aggregate inventory information of two products with consumers and when it is optimal to do so. A retailer sells two vertically-differentiated products. The seller might share the aggregate inventory level rather than each version's separate inventory information with customers. We show that the aggregate inventory information sharing is an ex-post optimal strategy if and only if the price of the high quality product is neither too high nor too low.

4 - Procurement Auctions with Error-Prone RFQs

Yan Yin, HEC Paris, 1 Rue de la Libération, Jouy-en-Josas, France, yin@hec.fr, Damian Beil, Hyun-Soo Ahn

Many requests for quotes (RFQs) contain errors that will trigger re-design (and windfall supplier profits) after production has begun. We study how the buyer's payment changes in the error rate, supplier's design knowledge, and competition intensity. Surprisingly, we find that a higher error rate can sometimes shrink the buyer's total payment by mitigating supplier windfall profits. We also show "pre-paying" re-design profits can be an alternative strategy to stem windfall profits.

■ WB42

Level 1 -101B

Collaborative Processes in Supply Chains and Services

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Nektarios Oraiopoulos, University Lecturer in Operations Management, Judge Business School, Cambridge University, Trumptington St., Cambridge, United Kingdom, n.oraiopoulos@jbs.cam.ac.uk

1 - Project Design with Limited Commitment and Teams

George Georgiadis, Post-doctoral Scholar, California Institute of Technology, California Institute of Technology, Los Angeles, CA, 90025, United States of America, georgiadis@ucla.edu, Christopher Tang, Steven Lippman

We study the interaction between a group of agents who exert costly effort over time to complete a project and a manager who chooses its requirements. The manager has limited commitment power so that she can commit to the requirements only when the project is sufficiently close to completion. This is common in projects involving design or quality objectives. The main result is that the manager has incentives to extend the project as it progresses. We then explore the implications of this result.

2 - Process-based Contractual Mechanisms for Collaborative Development Initiatives

Nektarios Oraiopoulos, University Lecturer in Operations Management, Judge Business School, Cambridge University, Trumptington St., Cambridge, United Kingdom, n.oraiopoulos@jbs.cam.ac.uk, Vishal Agrawal

In this paper, we study initiatives for co-development of new products and technologies. In such settings, it may be difficult a priori to specify contracts contingent on the outcome. Therefore, we investigate the efficacy of different process-based contracts, which instead specify the decision-making process.

3 - Free Riding and Leadership Structure in Collaborative Projects

Morvarid Rahmani, Assistant Professor, Georgia Institute of Technology, 800 West Peachtree, N.W., Atlanta, GA, 30308, United States of America, morvarid.rahmani@scheller.gatech.edu, Uday Karmarkar, Guillaume Roels

Knowledge-based projects are inherently team-based and their major resource is labor. We study the effect of leadership on effort choice and free riding in such projects. We show that there is always effort under-provision when members choose their effort. With a leader, there could be effort under- or over-provision. Comparing the efficiency of the two structures, we show that letting team members decide their effort generates a higher total surplus when both project reward and team are small.

■ WB43

Level 1 -101C

Topics in Supply Chain Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Nitin Bakshi, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, nbakshi@london.edu

Co-Chair: Sarang Deo, Indian School of Business, ISB Campus, Gachibowli, Hyderabad, 500032, India, Sarang_Deo@isb.edu

1 - Supply Allocation to Maintain Supplier Health in Development-intensive Supply Chains

Mericcan Usta, PhD Candidate, Stanford University, 245 Huang Engineering Center, Stanford, CA, 94305, United States of America, usta@stanford.edu, Feryal Erhun, Warren H. Hausman

We analyze the impact of the buyer's financial health concerns of suppliers on his supplier selection. We formulate a mathematical model where multiple suppliers compete for a divisible supply across multiple periods. Inclusion of the buyer's financial health concerns reveals dynamics that have been overlooked in the previous literatures on supplier selection and supply risk.

2 - Drivers of Unsaleables in Retail Supply Chains

Arzum Akkas, Massachusetts Institute of Technology, Cambridge, MA, United States of America, arzumakkas@gmail.com, David Simchi-Levi

This paper analyses the drivers of product expiration in the consumer packaged goods industry. We apply binomial regression on proprietary archival data where we establish a relationship between product returns and a number of factors that are believed to cause expiration. Our framework of analysis allows companies to identify the main drivers of product expiration in their supply chain, understand their relative impact, and estimate the benefits of possible initiatives to reduce expiration.

3 - Planning Production Capacity for Uncertain Scale-economies

Aadhaar Chaturvedi, Assistant Professor, Univeristy of Namur, Rempart de la Vierge 8, Namur, 5000, Belgium, aadhaar.chaturvedi@fundp.ac.be, Nishant Mishra

In quickly scaling-up production capacity for products such as photovoltaic cells, that are manufactured using novel production technologies leading to uncertain scale economies, the manufacturer runs the risk of being over-capacitated. In this paper we present a model that captures the trade-off between the risk of being over-capacitated in scaling-up quickly and the loss of market opportunity in scaling-up slowly, and analyze the optimal rate of capacity scale-up.

4 - Contracting for Initial Acquisition and After-sales Service in the Presence of Lifetime Buy Planning

Dong Li, Erasmus University, Rotterdam School of Management, PO Box 1738, Rotterdam, Netherlands, dli@rsm.nl, Nishant Mishra

We look at contracting under warranty + transaction-based contract (W+T) and performance-based contract (PBC), in a supply chain where equipment downtime impacts the customer's revenue, and lifetime buy planning is considered to manage component obsolescence. We find that PBC can result in higher product availability, but may result in lower efficiency. However, with low obsolescence cost, longer warranty can result in higher profit, despite spare parts inventory backorder.

■ WB44

Level 1 -101D

Supply Chain: Optimization II

Contributed Session

Chair: Kurt Masten, Ph.D. Candidate, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, kam478@drexel.edu

1 - Non-cooperative Trade-offs among Design Quality and Cost-reducing R&D in a Supply Chain

Fouad El Ouardighi, ESSEC Business School, BP 105, Cergy Pontoise, France, elouardighi@essec.fr, Victoire Denoyel, Juan-Carlos Espinoza

We develop a supply chain game model to determine how a manufacturer and its supplier should allocate their individual efforts between improving the design quality of a given product and reducing its production cost. Two compensation schemes are considered, wholesale price contract and two-part tariff scheme. In order to distinguish between dynamic from strategic effects, we derive the open-loop and Markov perfect closed-loop Nash equilibria, with the cooperative solution as a benchmark.

2 - Determining the Optimal Location for the Push-pull Boundary in a Supply Chain

Kathleen Iacocca, University of Scranton, 439 Brennan Hall, University of Scranton, Scranton, PA, 18510, United States of America, kathleen.iacocca@scranton.edu, Kingsley Gnanendran

We present an optimization model to determine the ideal location for the push-pull boundary (PPB) in a supply chain. We make a key assumption that the reduced response time from locating the PPB further downstream results in increased product demand. On the other hand, however, locating the PPB upstream reduces both working capital requirements (because the buffered inventory has a lower added value) as well as the cost of demand/supply mismatch (arising from lost sales and/or overstock).

3 - A Conceptual Research Design of the Logistics Service Providers Innovation Mechanism in the Gulf Region

Balan Sundarakani, Associate Professor, University of Wollongong in Dubai, Knowledge Village, Dubai, United Arab Emirates, balansundarakani@uowdubai.ac.ae

Logistics service providers (LSPs) are under heavy pressure to provide sustainable logistics services. Innovation is becoming a key strategy for LSPs to survive and also to thrive in the intense competition. This research work is aimed to examine the innovation processes and its related mechanism of LSPs who are existing in the Gulf Cooperative Council (GCC) region. By investigating the critical drivers that stimulates LSPs for innovation it develops some useful industry propositions.

4 - Buyer's Opportunity Costs in Lot-Splitting JIT Supply Chain Coordination

Kurt Masten, Ph.D. Candidate, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, kam478@drexel.edu

An opportunity cost reflecting the buyer's loss of future flexibility from a finite contract commitment has previously been incorporated into the solution to the buyer-supplier jointly optimal production and delivery policies in a lot-splitting JIT supply chain. This cost plays a critical role in the model but little research has explored this novel concept. A framework considering risks such as demand disruptions and price hedging is presented to increase understanding of this cost.

■ WB45

Level 1 -101E

Organizational Learning and Healthcare Performance

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Claire Senot, The Ohio State University, 2100 Neil Ave., Columbus, United States of America, senot_1@fisher.osu.edu

1 - A Day in the Saddle Can Take its Toll

Bradley Staats, Univrsity of North Carolina, Chapel Hill, NC, United States of America, Bradley_Staats@kenan-flagler.unc.edu, Hengchen Dai, Katy Milkman, Dave Hofmann

To deliver services safely, organizations develop professional standards. Despite the reinforcement of these standards, they are often not followed. In this paper we examine: (1) compliance to standards; (2) how high job demands may decrease compliance; (3) whether longer breaks increase compliance. We tested these hypotheses using longitudinal field observations of over 4,157 caregivers' in healthcare whose compliance with hand hygiene guidelines was recorded on 13.7 million occasions.

2 - The Impact of Learning-curve Heterogeneity and Team Familiarity on Orthopedic Procedure Times

Michael Lapré, Vanderbilt University, Owen Graduate School of Management, 401 21st Ave. South, Nashville, TN, 37203, United States of America, Michael.Lapre@owen.vanderbilt.edu, David Moore

We study orthopedic procedure times. We find (1) learning-curve heterogeneity exists for both individual and team experience; (2) learning from team experience depends on familiarity between team members who have to closely coordinate tasks; (3) when we allow for learning-curve heterogeneity for individuals and teams, organizational experiences is not significant.

3 - Strategic Asset Management of Equipment in a Multi-specialty Hospital

Kingshuk Sinha, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Scott Bosch, Ujjal Mukherjee, Shoubhik Sinha, Alex Cherucheril

An empirically grounded framework is proposed for optimal maintenance and service of various classes of medical equipment in a multi-specialty hospital categorized by criticality and complexity of the equipment. Hardware, software and user errors underlying medical equipment failures over time are analyzed to gain insights into differential effects of learning.

4 - Routines and Hospitals' Performance Path: Avolution along Conformance and Experiential Quality

Claire Senot, The Ohio State University, 2100 Neil Ave., Columbus, United States of America, senot_1@fisher.osu.edu, Aravind Chandrasekaran, Peter T. Ward

Using the theoretical lens of routines, we investigate the relationships between hospitals' structural characteristics (size & task complexity), infrastructural mechanisms (agency) and initial progression along conformance and experiential quality dimensions of the process of care. Findings reveal that size and complexity are negatively related to simultaneous improvement. However, a partial mediation through agency helps countering this effect.

■ WB46

Level 1 -101F

Environmental Considerations in Business Operations-II

Contributed Session

Chair: Thomas Sloan, University of Massachusetts Lowell, 1 University Avenue, Manning School of Bus. / OIS Dept., Lowell, MA, 01854, United States of America, Thomas_Sloan@uml.edu

1 - Reserving Capacity to Enable Green Investments - Effects on Inventory, Capacity, and Environmental Performance

Fredrik Eng-Larsson, Student, Lund University, PO Box 118, Lund, Sweden, fredrik.eng_larsson@tlog.lth.se, Peter Berling

Among firms buying transport services, capacity reservations have become increasingly common as a tool to create incentives for green investments. We analyze the efficiency of such reservations by considering a transport service provider that sells services to a downstream buyer, who uses the transports to replenish a warehouse that faces stochastic demand over multiple periods. We investigate the effects of capacity reservations on inventory, capacity investment and environmental performance.

2 - Supplier-buyer Partnership and the Linkage to Joint Environmental Performance

Chien-Ming Chen, Assistant Professor, Nanyang Technological University, Nanyang Business School, 50 Nanyang Avenue, Singapore, Singapore, cmchen@ntu.edu.sg, Kai Hoberg

Companies are facing mounting pressure to extend the scope of environmental management beyond the corporate borders. The extant literature has yet to investigate the main factors and mechanism through which a company may influence its suppliers' or customers' environmental performance. As a first attempt in this direction, this study presents an empirical analysis of the linkage between suppliers' and buyers' environmental performance.

3 - How to Balance Cost, Environment, and Safety in Cleaning Solvent Choices: An MCDM Approach

Thomas Sloan, University of Massachusetts Lowell, 1 University Avenue, Manning School of Bus. / OIS Dept., Lowell, MA, 01854, United States of America, Thomas_Sloan@uml.edu, Joseph Sarkis

Multi-criteria decision making (MCDM) methods are used to examine trade-offs between environmental, safety, and cost performance of different cleaning solvents. Using the CleanerSolutions database from UMass Lowell's Toxics Use Reduction Institute (TURI), we aim to create a dashboard to assist practitioners make informed decisions about cleaning solvent alternatives.

4 - Sustainable Supply Chain Management and the Triple Bottom Line EIO Modeling

Murat Kucukvar, University of Central Florida, Engineering II, University of Central Fl, Orlando, FL, 32817, United States of America, kucukvar@knights.ucf.edu, Gokhan Egilmez, Omer Tatari

This research integrates the triple-bottom-line sustainability assessment framework with the economic input-output modeling. U.S. food manufacturing sectors are analyzed as a case study. Direct and indirect environmental, economic and social impacts of each food manufacturing sector have been quantified by tracing the interactions between the U.S. economic sectors.

■ WB47

Level 1 -101G

Operations Management II: Stochastic Optimization in OM

Contributed Session

Chair: Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy 404, San Marcos, TX, 78666, United States of America, t_e18@txstate.edu

1 - The Impact of Flexibility and Capacity Allocation on the Performance of Primary Care Practices

Hari Balasubramanian, University of Massachusetts Amherst, 160 Governors Drive, Amherst, MA, 01003, United States of America, hbalasubraman@ecs.umass.edu, Xiaoling Gao, Ana Muriel

We adapt ideas of manufacturing process flexibility to the management of continuity and timely access in primary care practices. Timely access focuses on the ability of a patient to get access to a physician. Continuity refers to building a strong relationship between patient and physician by maximizing patient visits. We develop a two-stage stochastic integer program to investigate optimal capacity allocation for prescheduled and same-day patients, and the value of different flexible policies.

2 - Stochastic Programming in Multi-stage Inventory Problem with Non-stationary Demand

Kejia Hu, University of California, Davis, One Shields Avenue, Davis, CA, 95616, United States of America, kjhu@ucdavis.edu, Yuche Chen, Yueyue Fan

This research uses stochastic programming in designing the optimal strategy facing non-stationary demand in news-vendor model. It is shown when demand is actually non-stationary, a huge loss occurs if adopting optimal policy developed under stationary assumption. Then considering the dependent and the independent successive ordering, involving previous ordering information into model greatly reduces the uncertainty in the non-stationary case and thus reduces the cost to a great extent.

3 - The Simple Optimal Worker Allocation in Limited-cycle Model with Multiple Period

Xianda Kong, Tokyo Metropolitan University, 6-6 Asahigaoka, Hino, Tokyo, Japan, xianda.kong@gmail.com, Hisashi Yamamoto, Masayuki Matsui, Jing Sun

We study the allocation of operators in a series manufacturing system when target processing time is random variable in limited-cycle model with multiple periods. In most unfixed cases, the result and efficiency of a certain period (or production cycle) are influenced not only by the risks which exist in current period but also by the risks which exist in the previous ones.

4 - Integrated Maintenance and Production Planning with Endogenous Uncertainty

Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy 404, San Marcos, TX, 78666, United States of America, t_e18@txstate.edu, Refik Soyer

We consider an integrated maintenance and production planning problem in which the randomness of the machine yield depends on the previous decisions. This is modeled using a two stage stochastic optimization with recourse setting under endogenous uncertainty. We provide a simulation-based approach via an augmented probability model over the sources of uncertainty and decision variables. Markov chain Monte Carlo methods are utilized to sample from the resulting non-standard distributions.

■ WB48

Level 1 -101H

Consumer Behavior and Service Operations Management

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Mirko Kremer, Penn State University, 460 Business Building, State College, United States of America, Mirko.Kremer@psu.edu

1 - Learning Quality through Service Outcomes

Senthil Veeraraghavan, University of Pennsylvania, Wharton School, 3730 Walnut Street, Philadelphia, PA, United States of America, senthilv@wharton.upenn.edu, Laurens Debo

We study a service provider whose service value is unknown to arriving customers. Service outcomes are random depending on the quality of the service provider. Customers decide whether to join the service, or renege from the service based on the limited service outcomes/reviews that they observe. We consider how service policies influence consumer learning and social welfare.

2 - Multi-server Ticket Queues with Learning Customers

Kaan Kuzu, Assistant Professor of SC&OM, University of Wisconsin - Milwaukee, PO Box 742, Lubar Hall S485, Milwaukee, WI, 53201, United States of America, kuzu@uwm.edu, Susan Xu

This study analyzes multi-server ticket queues with balking and reneging customers. We propose the introduction of learning time epochs, at which customers learn about their current state and make abandonment decisions, for modeling customer behavior during waits. We develop the framework for ticket queue analysis with general patience time distributions. Finally, we compare the system performance of our proposed model with that of traditional models using static patience times for customers.

3 - Is Capacity Rationing Optimal When Customers Use Anecdotal Reasoning?

Tingliang Huang, Assistant Professor, University College London, Gower Street, Department of Management Science & Innov, London, WC1E 6BT, United Kingdom, t.huang@ucl.ac.uk, Qian Liu

We study strategic capacity rationing when customers have boundedly rational expectations in the sense of anecdotal reasoning. Our S(K) model generalizes the existing literature by allowing customer expectations to be boundedly rational.

4 - Would the Social Planner Let Bags Fly Free?

Gad Allon, Professor, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Martin Lariviere, Achal Bassamboo

In June 2008, American Airlines became the first major US airline to institute a fee on the first checked bag. Within 18 months, nearly every other major carrier followed suit. Here, we examine whether the fees are socially efficient. We find that the fees are in fact Pareto improving. While customers may dislike the fees, they are a means to alter customer behavior and thus reduce the airline's costs. Customers are compensated by lower base fares.

■ WB49

Level 1 -101I

Superquantiles and Their Applications to Risk, Random Variables, and Regression

Cluster: Tutorials

Invited Session

Chair: R. Tyrrell Rockafellar, University of Washington, Department of Mathematics, Seattle, WA, 98195, United States of America, rtr@math.washington.edu

1 - Superquantiles and their Applications to Risk, Random Variables, and Regression

R. Tyrrell Rockafellar, University of Washington, Department of Mathematics, Seattle, WA, 98195, United States of America, rtr@math.washington.edu, Johannes O. Røyset

Superquantiles are useful tools in risk modeling and optimization, with expanding roles beyond these areas. This tutorial provides a broad overview of superquantiles and their versatile applications. We see that superquantiles are as fundamental to the description of a random variable as the cumulative distribution function (cdf), they can recover the corresponding quantile function through differentiation, they are dual in some sense to superexpectations, which are convex functions uniquely defining the cdf, and they also characterize convergence in distribution. A superdistribution function defined by superquantiles leads to higher-order superquantiles as well as new measures of risk and error, with important applications in risk modeling and generalized regression.

■ WB50

Level 1 -101J

Analytics-based Business Applications

Contributed Session

Chair: Amir Kashani, PhD Student, University of Maryland, 1306 Monroe St. NW, Washington, DC, 20010, United States of America, akashani@umd.edu

1 - Four Killer Competencies Of Analytically Mature Corporations
Randy Bartlett, Business Analytics Leader, Blue Sigma Analytics, 105 Shelbourne Lane, Phoenixville, PA, 19460, United States of America, randeroid@aol.com

There are four major competencies possessed by analytically mature corporations: Pursuing Information; Quant leadership; Quant Involvement; and Analytics-based decision making. Effective corporations possess data-collection expertise. Their leadership includes a CAO watching the horizon; analytics-based decision makers; and a Business Analytics Leader to complete a Quant Led Quant Team (QLQT). Quants must interact closely with other professionals and decision makers must leverate the facts.

2 - Integrate SAP Solution Manager processes into IBM Business Process Manager
Feng Chen, Researcher, IBM Research-China, Beijing, Beijing, China, chenfbj@cn.ibm.com, Changrui Ren, Qinhua Wang, Qiang Wei

SAP is a worldwide leader in ERP software. SAP Solution Manager is a centralized support and system management suite, it provides facilities to manage thousands of process. IBM IBM Business Process Manager is one of the most successful BPM products. In this paper, a framework for integration SAP Solution Manager processes into IBM BPM is proposed. The framework closes the gap between SAP system and IBM BPM system, enables full life-cycle of process-centric enterprise system implementation.

3 - Preventive Maintenance for Mortgage Loans of Low-income Borrowers
Feng Xu, Georgia Southwestern State University, 800 GSW State University Drive, Americus, GA, 31709, United States of America, fenghsu@hotmail.com, Refik Soyer

To manage mortgage default and foreclosure risks, current practice is to offer post-default loss mitigations to borrowers with financial troubles. Research in this area focuses on analyzing the effectiveness of options and factors influencing outcomes of loss mitigations. In this paper we propose preventive loan maintenance models for determining optimal time of carrying out loss mitigation practices. We note that it is cost-effective to provide pre-default mitigations for risky mortgage loans.

4 - Empirical Analysis of On-line Penny Auction under Bidder Learning
Jin Li, City University of Hong Kong, 81 Tat Chee Avenue, Hong Kong, Hong Kong - PRC, lijingold@gmail.com

Penny auction broke out as a new auction form that the classical game theories have limitations to explain those bidder behaviors in the penny auction. We analyze bidder behaviors from the view of Bayesian learning. We find evidences for both direct experience learning and indirect experience learning.

5 - Trade-off Analysis for New Product Warranty Design
Amir Kashani, PhD Student, University of Maryland, 1306 Monroe St. NW, Washington, DC, 20010, United States of America, akashani@umd.edu, Ali Shafahi, Peter Sandborn

There are many factors involved in design and launch of a new product. One of the major challenges is designing an optimum warranty to signal the customers about reliability of product. The other challenge is minimizing the risks associated with unknown defects and customer behavior. This work uses simulation to tackle such trade-off analysis.

■ WB51

Level 1 -102D

Queuing Network Applications

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu

1 - Online Learning in Multi-tiered Queueing Networks
Stephen Barr, Graduate Student, University of Washington, UW Foster School of Business, Box 353200, Seattle, WA, 98195-3200, United States of America, stevejb@uw.edu

In multi-tiered queueing networks, we have traditionally been concerned with long-run average performance. However, a particular customer reveals information about themselves with every decision, and this information, combined with the state of the system, can be used to predict the customers' remaining path and optimally allocate resources to maximize system performance. Utilizing machine learning, I investigate methods to optimize the real-time performance of a multi-tiered queueing network.

2 - Computational Mixed Convexity Results for the Erlang Delay and Loss Formulae in Telecommunication Network Queuing Systems
Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu, Hillel Kumin

In queueing theory, the known results for the Erlang delay and loss formulae convexity are determined by either assuming the discrete variable, the number of servers, or the real variable, the service rate, is constant. In this work, compared to the known convexity results in the literature, strong computational mixed convexity results are obtained for the Erlang delay and loss formulae by applying a new convexity technique.

■ WB52

Level 1 -102E

Innovative Applications of Routing Problems III

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Yun Bai, University of Illinois, Champaign, IL, United States of America, yunbai1@illinois.edu

1 - An Exact Method for the Orienteering Problem with Time Windows
Andrés L. Medaglia, Associate Professor, Universidad de los Andes, Departamento de Ingenierìa Industrial, COPA, Bogota, Colombia, amedagli@uniandes.edu.co, Leonardo Lozano, Daniel Duque

The Orienteering Problem with Time Windows (OPTW) is the problem of finding a tour that maximizes the profit available at the nodes in a time-constrained network. The OPTW has multiple applications in transportation, telecommunications, and scheduling. We extended an exact method for the Elementary Shortest Path Problem with Resource Constraints (ESPPRC) to incorporate problem specific knowledge. We tested our method on instances derived from the well-known dataset by Solomon.

2 - Model and Algorithm for Robust Vehicle Routing Problem with Deadlines
Yossiri Adulyasak, Postdoctoral Associate, Singapore-MIT Alliance for Research and Technology (SMART), 1 Create Way, #10-01 Create Tower, Singapore, 138602, Singapore, yossiri@smart.mit.edu, Patrick Jaillet

We consider a routing problem under travel time uncertainty where deadlines are imposed at a subset of nodes. The objective of the problem is to optimize a performance measure, called lateness index, which represents the risk of violating the deadlines. We introduce a formulation and a decomposition algorithm that can be generalized to solve the problem with multiple capacitated vehicles.

3 - A Periodic Vehicle Routing Problem with Inventory
Qiong Zhang, University of Iowa, 108 John Pappajohn, S343 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, qiong-zhang@uiowa.edu, Luca Bertazzi, Jeffrey Ohlmann

We study a periodic vehicle routing problem with inventory considerations. We examine the relationship between our model formulation and the more general inventory routing problem. We present preliminary results on a solution approach.

■ WB53

Level 1 -102F

Transportation Network Design

Contributed Session

Chair: Xiaolei Guo, Assistant Professor, University of Windsor, 401 Sunset Ave., Odette School of Business, Windsor, ON, Canada, guoxl@uwindsor.ca

1 - Transportation Network Design in Megaregions: Impact on Economic Development

Mostafa Mollanejad, University of Maryland, 1173 Glenn Martin Hall, College Park, MD, 20742, United States of America, mostafa@umd.edu, Sapeksha Virinchi Vemulapati, Lei Zhang

This paper quantifies the impact of inter-city transportation investments on economic development in megaregions. The proposed model selects projects which maximize the total Gross Domestic Product of the region at the end of the planning horizon. Final GDP of each city is determined according to its resultant population and its historical trend of per-capita GDP. To provide the final populations, migrating population is estimated and redistributed based on the new accessibility of cities.

2 - Toll Road Competition with Boundedly Rational Road Users

Xiaolei Guo, Assistant Professor, University of Windsor, 401 Sunset Ave., Odette School of Business, Windsor, ON, Canada, guoxl@uwindsor.ca

Because boundedly rational user equilibrium (BRUE) always has a set of solutions instead of a unique one, a static toll road competition equilibrium does not exist under BRUE, i.e., there does not exist a toll vector under which every firm's profit is maximized given other firms' toll levels. In this study, from a disequilibrium flow evolution perspective, we look into the possibility of a dynamic toll road competition equilibrium with boundedly rational road users.

3 - Infrastructure Network Design under Additive Service Utilities

Xiaopeng Li, Mississippi State University, Department of Civil and Environmental En, PO Box 9546, 235L Walker Hall, 501 Hardy, Mississippi State, MS, 39759, United States of America, xli@cee.msstate.edu, Hugh Medal, Jin Wang

This paper studies a connected infrastructure network design problem that considers additive utilities from different infrastructure components. Analytical properties of the optimal design under certain special settings are discovered. A set of integer programming model formulations and customized algorithms are proposed to solve problem instances with more general settings. A set of numerical examples are conducted to test these models and draw insights.

4 - A Model for Optimal Location of Urban Bus Terminals

Cristian Palma, Assistant Professor, Universidad del Desarrollo, Avda Sanhueza 1750, Concepciòn, Chile, cristianpalma@ingenieros.udd.cl, Richard Zapata, Verònica Esparza, Macarena Lòpez

In Chile, the urban public transportation is managed by private companies that are legally required to have a bus terminal in one of the extremes of each route. Due to the high costs and limited land availability, companies have not been able to meet this requirement, therefore motivating a unified solution approach. We present a model that optimally locates these terminals from a set of potential locations, and show the results of its application in Concepcion, the Chilean second largest city.

5 - A Bi-criterion Approach to Evaluate Alternative Routing of Hazardous Materials

Ashrafur Rahman, University of Connecticut, 261 Glenbrook Road, Unit 3037, Storrs, CT, 06269, United States of America, arahman@engr.uconn.edu, Nicholas Lownes

We propose a bi-criterion model that accounts for the objectives of a regulator and the hazmat carriers. We define link risk using a decay function, travel time, traffic volume, and population. The combination of two objectives requires a trade-off between the network risk and the cost that allows the regulators to identify a hazmat transportation network.

■ WB54

Level 1 -103A

Recent Advances for Modeling Day-to-Day Traffic Assignment

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Xiaozheng He, Research Associate, Purdue University, NEXTRANS Center, 3000 Kent Ave., West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu

1 - A Dynamical System Based Formulation to Represent the Day-to-Day Dynamics of Transportation Network

Amit Kumar, Purdue University, NEXTRANS, 3000 Kent Ave., West Lafayette, IN, 47906, United States of America, kumar44@purdue.edu, Srinivas Peeta

We develop a dynamical system based model to represent the evolution of path flows resulting from the day-to-day dynamics in the state of disequilibrium of transportation network under static demand. The proposed model is based on the proportional-switch adjustment process and is derived using insights from the multi-commodity economic market. The solution methodology is discussed and computational results are presented for a study network.

2 - Evolutionary Game and Realization Probability of Traffic User Equilibria

Rui Ma, Research Assistant, Rensselaer Polytechnic Institute, 110 8th Street, JEC 5107, Troy, NY, 12180, United States of America, mar2@rpi.edu, Xuegang Ban

We study the realization probability of user equilibrium via investigating the day to day equilibration process of traffic flow. An evolutionary game approach is proposed and numerical results are shown.

3 - Game-Theoretic Learning Models in Traffic Assignment

Tarun Rambha, The University of Texas at Austin, 301 E Dean Keeton St., Stop C1761, Austin, United States of America, tarun.1988@gmail.com, Kai Yin, Stephen Boyles

"Fictitious play in atomic congestion games is known to converge to Nash Equilibrium. We explore other learning strategies in the context of traffic networks and examine the impact of travel time information and past experiences of users on the convergence of repeated play.

4 - On Marginal Decision Rule in Day-to-Day Traffic Assignment

Xiaozheng He, Research Associate, Purdue University, NEXTRANS Center, 3000 Kent Ave., West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu, Srinivas Peeta

We propose a marginal decision rule based on the law of diminishing marginal utility to model traveler day-to-day route choice behavior. We investigate the relationship between the marginal decision rule and traveler?s rational and boundedly rational behaviors. A day-to-day traffic assignment model based on the marginal decision rule is explored in terms of the evolution of the traffic pattern towards the classical or boundedly rational user equilibrium cases.

■ WB55

Level 1 -103B

Production Scheduling

Contributed Session

Chair: Anastasia Spathi, Researcher, University of Thessaly, Pedion Areos, Volos, 38334, Greece, sp.anastasia@gmail.com

1 - Iterated Local Search and Constructive Heuristics for Minimizing Total Tardiness in Flexible Job Shop

Everton Melo, Ph.D. student, Universidade de São Paulo, Avenida Professor Luciano Gualberto, 530, São Paulo, Brazil, everton_lm@yahoo.com.br, Débora Ronconi

An Iterated Local Search (ILS) is used to minimize total tardiness in the Flexible Job Shop. New priority rules associated with list scheduling algorithms that exploit characteristics of the problem are proposed. The ILS uses a larger neighborhood than the literature reference. Computational tests using a new set of 600 instances show that the proposed priority rules outperform the literature rules. Moreover the proposed ILS has a better performance than the literature reference metaheuristic.

2 - Production Scheduling and Planning for Production with Sequence-dependent Changeovers
Qingwei Li, Eastman Chemical Company, 200 S Wilcox Dr., Kingsport, United States of America, qli@eastman.com

The production of products is campaigned to reduce set-up and clean-out cost, and achieve higher product quality. To minimize the total change-over cost in production, we developed a multi-line, multi-product discrete lot-sizing model with sequence-dependent change-over cost. As a result, a 34% reduction in the total number of change-overs was observed. It is estimated this model saves more than $1 million dollars per year.

3 - Resource and Demand Management in IT Services
Kaan Katircioglu, IBM, IBM Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, kaan@us.ibm.com, Pu Huang, Rich Segal

We present an IT service resource planning problem. Each job requires a known set of IT skills and has a probability of occurring in a given time period. Resources need to be planned in advance since changes in resources take time. The objective is to manage skill capacity optimally so that skill utilization is maximized and the jobs are processed on time. We will present a formulation of the problem, and a heuristics for optimized skill capacity planning and job scheduling.

■ WB56

Level 1 -103C

Energy Efficiency and Demand Response Modeling

Sponsor: Energy, Natural Resources and the Environment/Energy
Sponsored Session

Chair: Enzo Sauma, Associate Professor, Pontificia Universidad Catolica de Chile, Ave. Vicuna Mackenna 4860, Santiago, RM, Chile, esauma@ing.puc.cl

1 - Simulation of a Tariff Flexible Scheme (TOU) in Chile, A Win – Win Situation
Sonia Vera, Department of Industrial & Systems Engineering, Pontificia Universidad Catòlica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, Chile, sverao@uc.cl, Enzo Sauma

A flexible tariff scheme could allow making better use of the power system in Chile. In this country, the residential sector faces a fixed pricing scheme. It does not include the increased cost of the system produced by the high variability of the load curve characteristic. We have simulated the effects it could have on the beneficial of DISCOs a new TOU system for electricity consumption in Chile, obtaining a win-win situation among DISCOs and consumers.

2 - Non-linear Model to Promote Energy Efficiency Programs in Power Distribution Companies
Karim Osorio, Pontificia Universidad Catòlica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, Chile, karimosorio@gmail.com, Enzo Sauma

We propose two bi-level models based on principal-agent theory in order to analyze possible economic effects of implementing different inventive mechanisms to foster energy efficiency in power distribution companies. The difference between both models is that in one, the energy savings are subject to uncertainty through the CVaR concept. In general terms, it is convenient for the government to adopt a performance-based incentive mechanism than a payment scheme financing the fixed costs.

3 - Power Generation Expansion Planning with Short-term Demand Response
Timo Lohmann, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, tlohmann@mines.edu, Steffen Rebennack

Demand response is the capability of load to react to short-term changes in electricity prices. As electricity markets become deregulated, it plays an increasingly important role. We present a long-term power generation expansion planning model with a short-term demand response function in its general form, and introduce a Benders Decomposition approach to solve it efficiently. We discuss possible extensions to the model and compare implementation options in GAMS.

■ WB57

Level 1 -103D

Modeling and Analysis on Energy Systems

Sponsor: Energy, Natural Resources and the Environment/Energy
Sponsored Session

Chair: Zhi Zhou, Argonne National Laboratory, 9700 South Cass Ave. Bldg. 221, Lemont, IL, 60437, United States of America, zzhou@anl.gov

1 - Power Gird Vulnerability Analysis with MIP Approximated AC Optimal Power Flow
Wei Yuan, United States of America, weiyuan@mail.usf.edu, Bo Zeng

Due to lack of algorithm to cope with the non-convex AC optimal power flow problem, the optimal power flow problem is often formulated as a linearized DC optimal power flow problem. However, this approach is often criticized because the DC optimal power flow fails to capture key features of the physical power grid, which may lead to a non-optimal vulnerability analysis. In this paper, we propose to use MIP to approximate the AC power flow problem to better capture the physics of power grid.

2 - Adaptive Operation Decisions for Smart Building Cluster
Mengqi Hu, Assistant Professor, Mississippi State University, PO Box 9542, 260 McCain Hall, Mississippi State, MS, 39762, United States of America, mhu@ise.msstate.edu

An adaptive decision framework is developed to derive operation decisions for the smart building cluster by considering system dynamic, uncertainties in the building and environment. The adaptive decision framework has three stages: decisions generation, execution, and calibration. The result demonstrates that the framework is able to derive adaptive operation decisions for the building cluster which could make buildings quickly respond to the dynamic environment, and achieve more cost savings.

3 - Short-term Wind Power Forecasting with Spatio-temporal Correlation Estimation
Zhi Zhou, Argonne National Laboratory, 9700 South Cass Ave. Bldg. 221, Lemont, IL, 60437, United States of America, zzhou@anl.gov, Audun Botterud

We enhance short-term wind power forecasting algorithms by considering temporal and spatial correlations of explanatory variables to capture the characterization of supply from wind resources across a large geographic area. A time-forward kriging predictor is modeled to estimate explanatory variables for a given look ahead time based on historical data in a predefined area, and then to predict the wind power output. The framework is tested on a real world dataset and compared to existing models.

■ WB59

Level 1 -103F

Agriculture and Natural Resources Management

Contributed Session

Chair: Richard Forrester, Associate Professor of Mathematics, Dickinson College, College and Louther Streets, Carlisle, PA, 17013, United States of America, forrestr@dickinson.edu

1 - Economic Model Evaluation of Sugar-beet Production in Red River Valley
Kambiz Farahmand, Professor, North Dakota State University, Department of Industrial and Manufacturi, NDSU Dept. 2485, P.O.Box 6050, Fargo, ND, 58108-6050, United States of America, kambiz.farahmand@ndsu.edu, Vahidhossein Khiabani, Nimish Dharmadhikari

A comprehensive economic model of Sugar-beet growing, transportation, and processing have been developed for the Red River valley to analyze the critical cost attributes and parameters. The main purpose of the proposed economic model is to incorporate changes in critical attributes directly as a result of forecast model(s) using remote senor data (NDVI) and in-situ sensor data, etc. in order to maximize yield and profits and to minimize associated cost at each phase of the production.

2 - Optimal Water Resource Allocation in Seasonally Dry Regions
Zhouyang Lu, Duke University, No. 8 Fochengxilu, Jiangning, Hohai University, Business School, Nanjing, JS, 211100, China, zl49@duke.edu, Jeannette Song

In seasonally dry regions, the distribution/allocation of water resource is an extremely critical and sensitive issue, and conflicts often occur due to lack of appropriate water allocation scheme. Among the many uses of water, the need of agricultural irrigation water is highly elastic, and has not yet been made full use. With a nonlinear programming model, this work designs an optimal distribution scheme of water resource for dry seasons to maximize benefits from precious water resources.

3 - Analysis of Transportation Economics of Sugar-beet in the Red River Valley of ND and MN using GIS

Nimish Dharmadhikari, North Dakota State University, Transportation and Logistics Program, UGPTI NDSU Dept: 2880, PO Box: 6050, Fargo, ND, 58108, United States of America, nimish.dharmadhikari@ndsu.edu, Kambiz Farahmand, Vahidhossein Khiabani

Sugar-beet is an important crop from socio-economic point of view in Red River valley of North Dakota and Minnesota. This research focuses on the transportation aspect of the sugar-beet processing. We present a model to calculate the total cost associated with the sugar-beet transportation. The minimization of the total transportation cost is achieved with the help of Geographical Information System (GIS).

4 - From Farm to Cup: The Kenya Coffee Supply Chain

Yao Zhao, Associate Professor, Rutgers University, Rutgers Business School, 1 Washington Street, Newark, 07102, United States of America, yaozhao@andromeda.rutgers.edu

The coffee crisis in year 2001-02 drove millions of small farmers world wide into extreme poverty. While the price fluctuation is the obvious cause, supply chain also plays a subtle and significant role. This talk reviews our empirical and analytical studies on Kenya's coffee supply chain to reveal the current practice and the result of various interventions, such as market liberalization, minimum price guarantee, and fair-trade coffee.

5 - Optimal Crop Rotation at the Dickinson College Organic Farm

Richard Forrester, Associate Professor of Mathematics, Dickinson College, College and Louther Streets, Carlisle, PA, 17013, United States of America, forrestr@dickinson.edu

Crop rotation is an important component of organic farming because it can help to maintain healthy soil and provide weed and pest control. Dickinson College has a certified organic farm consisting of 24 different fields that grow 13 different crop groups. We develop a mixed-integer program that determines a four-year crop rotation schedule that takes into account crop yield requirements, irrigation type, weed control, feed habits, and other considerations.

■ WB60

Mezzanine - 100A

Joint Session DM/HAS/AI: Simulation Modeling in Health Care

Sponsor: Data Mining, Health Applications & Artificial Intelligence

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 E Fowler Ave. ENB118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Multi-objective Programming with Simulation Optimization to Improve Patient Flow Distribution

Jie Song, Peking University, NO. 298,Chengfu Road,Haidian District, Beijing, 100871, China, songjie@coe.pku.edu.cn, Yunzhe Qiu

Our research proposed a methodology to find the optimal patient flow with multi-dimension inputs and outputs for the multi-level healthcare system. Our approach integrates multi-objective programming and simulation optimization , and an algorithm based on Stochastic Approximation and improved by the Response Surface Method is used. A local case study is carried out, and a comparison between our optimization algorithm to the Random Search Approach indicates that our method is faster.

2 - Mathematical Model and Agent-based Model: A Comparative Study on the Performance of Sepsis

Chih-Hang(John) Wu, Associate Professor, Kansas State University, 2037 Durland Hall, Manhattan, KS, 66506, United States of America, chw@ksu.edu, Zhenzhen Shi, David Ben-Arieh

We present a system dynamics mathematical model and multi-agent-based model (MABM), which model and simulate the innate immunity and adaptive immunity of sepsis, especially getting insights into the time and intensity of intervention of anti-inflammatory cytokines in sepsis evolution. By comparing the results from both models, we conclude that MABM is more realistic approach to simulate sepsis progression.

3 - Integrating Patient Compliance Models into a Diabetic Retinopathy Screening Evaluation Simulation

Irene Vidyanti, University of Southern California, 1179 W 29th Street, Los Angeles, CA, 90007, United States of America, vidyanti@usc.edu, Shinyi Wu

Current simulation models to aid evaluation of screening strategies do not have a structure that enables the evaluation of strategies that include policies affecting screening compliance, even though such strategies are often necessary to achieve maximum cost-benefit, especially when current compliance levels are low. This research develops a model addressing the shortcoming by including compliance as a mediating variable in the model and illustrates this using the case of Diabetic Retinopathy.

4 - Nonlinear Modeling of Spiral Wave Formation and Turbulent Patterns in High-dimensional Systems

Yun Chen, University of South Florida, 4202 E. Fowler Ave., Tampa, FL, 33620, United States of America, yunchen@mail.usf.edu, Hui Yang

Real-world dynamical systems often exhibit complex spiral wave dynamics and turbulent patterns. Many previous investigations focused on such space-time patterns on the regular 2D surfaces. This paper presents a dimensionality reduction approach for modeling nonlinear reaction-diffusion mechanisms in high-dimensional systems. This present investigation shows great potentials for characterizing and quantifying space-time dynamics in high-dimensional systems.

■ WB61

Mezzanine - 100B

CS and OR Interface

Contributed Session

Chair: Sarah Powers, Oak Ridge National Laboratory, One Bethel Valley Road, Oak Ridge, TN, United States of America, powersss@ornl.gov

1 - A New Embedded Feature Selection Method for High Dimensional Datasets

Vijay Pappu, Graduate Assistant, University of Florida, 401 Weil Hall, Gainesville, FL, 32611, United States of America, psnvijay@ufl.edu, Panos Pardalos, Paul Thottakkara, Pando Georgiev

A new embedded feature selection method for high dimensional datasets is introduced by incorporating sparsity in Proximal Support Vector Machines (PSVMs). Our method learns a sparse representation of PSVMs by first casting it as an equivalent least squares problem and then introducing the l1-norm for sparsity. An efficient algorithm based on alternate optimization techniques is proposed. Classification performance on several publicly available datasets is also presented.

2 - Improving HPC Scheduling using Predictive Analytics

Sarah Powers, Oak Ridge National Laboratory, One Bethel Valley Road, Oak Ridge, TN, United States of America, powersss@ornl.gov, Steve Poole

In a High Performance Computing (HPC) environment, optimizing computational resources is key while meeting user demands and minimizing cost (e.g., energy consumption). Using historical data, we propose to implement predictive models of jobs arrivals, giving the schedule a chance to peek at upcoming scheduling needs, and improve upon the case with unknown future demand. A use case with performance results is presented.

■ WB62

Mezzanine - 100C

Industrial Data Analytics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Shiyu Zhou, Professor, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, szhou@engr.wisc.edu

1 - Remaining Useful Life Prediction for Automotive Batteries

Qiang Zhou, Assistant Professor, City University of Hong Kong, Dept. of Systems Eng & Eng Mgnt, Kownloon, Hong Kong - PRC, q.zhou@cityu.edu.hk, Junbo Son, Shiyu Zhou, Xiaofeng Mao, Mutasim Salman

Many failures in engineering can be traced back to some underlying degradation processes. We propose a two-stage prognostic framework for individual units subject to hard failure, based on joint modeling of degradation signal and time-to-event data.Its application in automotive battery residual life prediction has been discussed in this paper as an example.

2 - Emerging Approaches and Challenges to 3D-Printing for Tissue Engineering

Rohan Shirwaiker, Assistant Professor, North Carolina State University, Dept of Industrial & Systems Engineering, 400 Daniels Hall, Raleigh, NC, 27695, United States of America, rashirwaiker@ncsu.edu, Sang Jin Lee

3D-Printing techniques provide the ability to design and fabricate unique configurations of scaffold structures that are central to new tissue or organ formation in tissue engineering. Recent advances have enabled a paradigm shift from statically seeded polymer scaffolds to integrated 3D matrices with direct-printed live cells, although several challenges still exist. These emerging approaches and the current challenges to their lab-to-clinic translation will be presented.

■ WB63

Mezzanine - 100D

Condition Monitoring and Prognostics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Arda Vanli, Assistant Professor, Florida State University, 2525 Pottsdamer St., Tallahassee, Fl, 32310, United States of America, avanli@fsu.edu

1 - A Failure-time Prediction Method for Condition-based Maintenance

Arda Vanli, Assistant Professor, Florida State University, 2525 Pottsdamer St., Tallahassee, Fl, 32310, United States of America, avanli@fsu.edu

This paper proposes a Bayesian approach for failure time prediction of degrading components from condition data that accounts for uncertainties and incorporates prior information on degradation behavior. The approach is based on posterior sampling to handle more general statistical models. It is illustrated with simulation that by incorporating condition monitoring data or including prior knowledge the effectiveness of maintenance decisions can be significantly improved.

2 - Determining Replacement Thresholds for System with Component Inter-dependency

Linkan Bian, Assistant Professor, Mississippi State University, 260 McCain Hall, Miss. State, MS, 39762, United States of America, linkanbian@gmail.com, Nagi Gebraeel

Inter-dependency among the components of an engineering system may affect the lifetimes of components in the system. Most conventional models that investigate the replacement of components are based on the assumption of independence. We propose a policy for determining the replacement thresholds of components while account for the inter-dependency among the components. We demonstrate via numerical studies that our proposed policy reduces the total replacement cost in the long run.

3 - Condition-based Maintenance for Degrading Systems

Petek Yontay, Arizona State University, 699 S. Mill Ave., Tempe, AZ, 85281, United States of America, pyontay@asu.edu, Rong Pan

In this research, we use offline condition monitoring to model and analyze degrading components. We investigate some performance parameters to assess reliability of the system. In order to illustrate our methodology, we will apply it on a real life industrial problem.

4 - Concrete Pavement Condition Monitoring using Fiber Bragg Grating Sensors

Ying Huang, North Dakota State University, Dept. of Civil Engineering, Fargo, ND, 58108, United States of America, ying.huang@ndsu.edu, Leonard Palek, Ben Worel, Maureen Jensen

For evaluation of the performance of concrete pavements, reliable infrastructure sensors are demanded. Traditional electrical sensors such as strain gauges and vibration wires, showed high electromagnetic interference (EMI), high dependence on environmental conditions such as moisture, and relatively short life cycle, which are unreliable for long-term pavement performance monitoring. Fiber Bragg grating (FBG) sensors, with unique advantages of compactness, immune to EMI and moisture, capability of quasi-distributed sensing, and long life cycle, will be a perfect candidate for long-term concrete pavement performance evaluation and condition monitoring. However, the FBG sensors also surfer from their frangible nature of glass materials for a good survive rate during concrete pavement construction. In this study, Fiber reinforced polymer (FRP) materials have been used to package the FBG sensors and further applied to evaluate the performance of concrete pavements, at MnROAD facility, Minnesota DOT (MnDOT). The design and layout of the FRP-FBG sensors, their field test setup, data acquisition, and data analysis for pavement condition evaluation will be presented. Upon validation, the FRP-FBG sensors can be applied for condition monitoring of concrete pavements to assistant pavement maintenance.

■ WB64

Mezzanine - 100E

Reliability: System Analysis

Contributed Session

Chair: Mohammed Shafae, Graduate Research Assistant, Virginia Tech, 250 Durham Hall, Virginia Tech, Blacksburg, VA, 24060, United States of America, shafae1@vt.edu

1 - A Comparative Study of Temperature-based Models for Battery State of Charge Estimation

Yinjiao Xing, PhD Candidate, City University of Hong Kong, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong - PRC, yxing3@student.cityu.edu.hk, Kwok-Leung Tsui

We proposed two temperature-based models (TR and TRC model) for battery state-of-charge estimation. Model adequacy and validation were performed at different temperatures. The unscented Kalman filtering was employed for estimating battery SOC. The SOC estimation based on temperature-based models presented smaller errors than the models without regard to temperature. In addition, TRC model would provide smaller estimated errors than TR model at low temperature but not at high temperature.

2 - An Analytic Approach to Modeling the On-station Availability of Systems of Unmanned Vehicles

John MacCarthy, Research Staff Member, Institute for Defense Analyses, 4850 Mark Center Dr., Alexandria, VA, 22311, United States of America, jmaccart@ida.org, Patricia Bronson

This paper describes a spiral-based modular modeling approach to the rapid development of analytical models of increasing fidelity that may be used to predict the on-station availability of complex systems consisting of multiple unmanned vehicles and multiple manned control stations, while changing the values of key parameters associated with the system architecture, system design, operational concept, and system maintenance concept. An example application of the method is provided.

3 - CUSUM Control Charts for Monitoring Weibull-distributed Time between Events

Mohammed Shafae, Graduate Research Assistant, Virginia Tech, 250 Durham Hall, Virginia Tech, Blacksburg, VA, 24060, United States of America, shafae1@vt.edu, Jaime Camelio, Rebecca M. Dickinson, William H. Woodall

Due to its flexibility Weibull distribution excels in modeling different failure mechanisms. In our paper, we evaluate the performance of three CUSUM control charts to monitor Weibull time between event (TBE) observations: Weibull CUSUM, exponential CUSUM, and proposed adjusted CUSUM charts. We show advantages in using one of the first and third charts which show similar performance.

■ WB65

Mezzanine - 100F

Traffic Operations

Contributed Session

Chair: SeyedBehzad Aghdashi, Research Assistant, North Carolina State University, 2510-203 Avent Ferry Rd., Raleigh, 27606, United States of America, saghdas@ncsu.edu

1 - Robust Signal Control under Uncertainty

Suh-Wen Chiou, National Dong Hwa University, Dahsueh Road, Hualien, 97401, Taiwan - ROC, chiou@mail.ndhu.edu.tw

A minmax bilevel program is used to formulate a signal setting problem for area traffic control optimization. A new solution algorithm is presented. Numerical computations are conducted.

2 - An Incremental Delay Methodology for Non-recurring Congestion on Freeway Facilities

ali Hajbabaie, Research Associate, North Carolina State University, centennial campus box 8601, Raleigh, NC, 27795-8601, United States of America, ahajbab@ncsu.edu, Nagui Rouphail

This study introduces an incremental method to estimate the effects of different sources of congestion on freeway travel time. The method relies on generating a complete set of scenarios to describe the operational variability over an extended study period and calculates the probability of each scenario. Then, it determines the contribution of different source of congestion to delay, distinguishing between the recurring, and the incremental delay caused by weather and incidents.

3 - Scenario Generation for Freeway Travel Time Reliability Analysis (Deterministic and Stochastic)
SeyedBehzad Aghdashi, Research Assistant, North Carolina State University, 2510-203 Avent Ferry Rd., Raleigh, 27606, United States of America, saghdas@ncsu.edu, Nagui Rouphail, Ali Hajbabaie

The scenario generation constructs the basis of the travel time reliability analysis for the freeway facilities. In this research a set of mathematical models are discussed that helps to model the variation in traffic demand, inclement weather conditions, and incidents that occur stochastically on the freeways.

4 - High-occupancy/toll Lanes with Lotteries and Auctions
Rafael Olarte, Ph.D. Candidate, University of Maryland, College Park, 5717 Lackawanna St., College Park, MD, 20740, United States of America, olarte@umd.edu, Ali Haghani

High-occupancy/toll lanes sell managed capacity to single-occupant vehicles (SOVs). These systems benefit SOVs who need a reliable and fast choice for arriving to their destination. Nonetheless, some frequent users who also favor a fast choice are not as concerned with its reliability (e.g. work-home trips). This presentation addresses these other users through a lottery. Designs and a game-theoretic model are provided. As demand for the lottery increases, it can be transformed into an auction.

5 - Optimization of Strategic and Tactical Level Transportation Policies
Yingtao Ren, Manhattan Associates, 2300 Windy Ridge Pkwy SE, 10th Floor, Atlanta, GA, 30339, United States of America, yren@manh.com

We present an innovative scenario analysis tool developed by Manhattan Associates for strategic and tactical level transportation policies. It evaluates and optimizes many important policies such as sourcing policy, delivery schedule, prepaid vs collect, etc. It synthesizes the strength of optimization to get the global optimal solution and the strength of simulation to simulate sophisticated realistic scenarios. It uses stochastic demand distribution as input to provide robust cost estimation.

■ WB66

Mezzanine - 100G

Supply Chain Information Systems

Sponsor: Information Systems

Sponsored Session

Chair: Manoj Vanajakumari, Assistant Professor, Texas A&M University, 3367 TAMU, College Station, TX, 77843, United States of America, manojuv@neo.tamu.edu

1 - A Distribution Game Model with Reciprocity Behavior and its Applications
Qinglong Gou, Dr., University of Science and Technology of China, School of Management, USTC, Jinzhai Road 96#, Hefei, AH, 230026, China, tslg@ustc.edu.cn, Yan Zhang, Juan Li

We propose a distribution game framework with consideration of the reciprocity behavior of human being. We use it to explain the Ultimatum game. We also use it to investigate the pricing decisions in a supply chain. Analysis shows the impact of a retailer's reciprocity behavior on the supply chain decisions.

2 - Information Sharing in a Multi-tier Supply Chain with Outsourcing
Yulan Wang, Assistant Professor, Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, Hong Kong - PRC, yulan.wang@polyu.edu.hk, Cheng Ma

We study the information sharing incentives in a three-tier supply chain consisting of an OEM, a CM and a supplier under two outsourcing structures, control and delegation by considering two production cost scenarios: production economy and production diseconomy. We then derived the information sharing equilibria for each combination of the outsourcing structures and production cost situation. We then identify under which situation information sharing can make the supply chain better off.

3 - New Product Pricing Strategies with Social Media Influences and Reference Price Effect
Xiuli He, Assistant Professor, Univeristy of North Carolina-Charlotte, 9201 University City Blvd, BISOM Dept., Charlotte, NC, 28223, United States of America, xhe8@uncc.edu, Juzhi Zhang, Qinglong Gou, Subodha Kumar

We propose a two-period model to study the reference price effect under social media influences. The consumers' utility valuation is uncertain and is affected by the online word-of-mouth effect and reference price effect.

4 - Value of Information in a Three Player System
Manoj Vanajakumari, Assistant Professor, Texas A&M University, 3367 TAMU, College Station, TX, 77843, United States of America, manojuv@neo.tamu.edu, Subodha Kumar

In this research we analyze a supply chain system consisting of a manufacturer, one dedicated and another temporary supplier. Under various levels of information exchange in the system, we derive the order quantities placed by the manufacturer to each of the suppliers.

■ WB68

Mezzanine - 100I

Healthcare Applications in OR/MS II

Sponsor: Decision Analysis

Sponsored Session

Chair: Nasibeh Azadeh-Fard, PhD Student, Virginia Tech, 401 Fairfax Rd., Apt. No. 631, Blacksburg, VA, 24060, United States of America, azadehfard@gmail.com

1 - Applications of Kitting Materials Feeding Policy to Healthcare: A Case Study in a Perioperative Services
Lawrence J. Bonczar, MS Student, University of Virginia, 151 Engineer's Way, Charlottesville, VA, 22903, United States of America, lbonczar@gmail.com, K. Preston White

Kitting involves the creation of kits of raw and sub-assembled components that in total amount to all of the material required for final assemblies. Most large hospitals assemble kits of instruments and disposable supplies for use during surgeries. The efficacy of the kitting process directly contributes to the quality of patient care during a surgical event. The paper reviews research on kitting as a materials feeding policy and applies it to a case study in a perioperative services department.

2 - Performance Metrics in Outpatient Healthcare: A Framework
Ken Klassen, Professor, Brock University, 500 Glenridge Ave., St. Catharines, ON, L2S3A1, Canada, kklassen@brocku.ca, Tugba Cayirli, Elham Torabi, Craig Froehle, Michael Magazine, Denise White

Precisely defined performance metrics are essential for managing and improving operations in an outpatient clinic. We review OM and healthcare literature and develop a comprehensive framework of performance metrics for outpatient operations. We demonstrate how the framework can be applied to prior research and can inform and motivate future work.

■ WB69

Mezzanine - 100J

Auctions and Mechanism Design II

Contributed Session

Chair: Ray Strong, IBM Research Almaden, 650 Harry Rd., San Jose, CA, 95120, United States of America, hrstrong@us.ibm.com

1 - A Bayesian Inference Approach towards Secondary Market Online B2B Auctions
Babak Zafari, The George Washington University, 2201 G Street NW, Funger Hall, Suite 415, Washington, DC, 20052, United States of America, zafari@gwu.edu

The experience of the bidders in the market and the available information in auctions can shape bidder's bidding behavior. In this study, we test to see under what situation the first bids are formed by focusing on bidder's experience, cross-bidding activity and the provided information in the auction environment. In so doing, we consider a dynamic probit model and follow the data augmentation approach to develop an exact Gibbs sampler for Bayesian analysis.

2 - Generalized Stable Matching in Bipartite Networks
Ankur Mani, PhD Candidate, Massachusetts Institute of Technology, 20 Ames St., #385, Cambridge, MA, 02139, United States of America, amani@mit.edu, Alex Pentland

We study the generalized stable matching problem in bipartite networks, the case when costless transfers between the matched agents is not possible, as in the central assignment game of kaneko, 1982. We present an algorithm that converges to a generalized stable matching that is optimal for one side of the network and identify conditions under which the algorithm runs in polynomial time.

3 - Generalized Reverse Japanese Auctions: Simple and Optimal Mechanism for Procurement

Shivam Gupta, Graduate Student, Univ of Texas at Dallas, Naveen Jindal School of Management, 800 West Campbell Road, Richardson, TX, 75080, United States of America, sxg104920@utdallas.edu, Wei Chen, Milind Dawande, Ganesh Janakiraman

We study the design of simple and optimal auctions for procurement under practical considerations. Such considerations include: (1) Business rules, limiting the number of suppliers selected and the percentage of business awarded to any selected supplier, (2) Suppliers' production capacities, and (3) Total cost of ownership.

4 - Market Driven Multi-dimensional Auction

Ray Strong, IBM Research Almaden, 650 Harry Rd., San Jose, CA, 95120, United States of America, hrstrong@us.ibm.com, Tobin Lehman, Melissa Cefkin, Yolanda Rankin

We describe a system supporting auctions with bid and asked hyper-surfaces in a hyper-space of price and descriptive dimensions. The system is intended to connect work requesters to work producers in the multi-dimensional space of work description. The user only has to deal with price points; but the system builds a market driven surface to describe the user's offering. The user can then customize the surface by indicating interest or disinterest in potentially matching offerings.

Wednesday, 1:30pm - 3:00pm

■ WC01

Level 2 - Room 200A

Optimization and Computation in Financial Engineering

Cluster: Optimization in Finance

Invited Session

Chair: Zhen Liu, Assistant Professor, University of Minnesota at Twin Cities, 206 Church St., S.E., Minneapolis, MN, 55455, United States of America, zhenliu@umn.edu

1 - Closed-form Expansions of Discretely Monitored Asian Options in Diffusion Models

Chao Shi, Mr, The Hong Kong University of Science and Technology, Room 002C, UA TOWER A, HKUST, Clear Water Bay, Kowloon, Hong Kong, Hong Kong - PRC, shichao@ust.hk, Ning Cai, Chenxu Li

We propose a closed-form asymptotic expansion approach to pricing discretely monitored Asian options in general one-dimensional diffusion models. It explicitly calculates any general expansion term in a systematic way. The convergence of the expansion is proved rigorously under some regularity conditions. Numerical experiments suggest that such expansion with only a few terms is accurate, fast, and easy to implement for a broad range of diffusion models.

2 - Unbiased Simulation of Distributions with Explicitly Known Integral Transforms

Nan Chen, Associate Professor, The Chinese University of Hong Kong, 709A William Mong Engineering Building, Hong Kong, Hong Kong - PRC, nchen@se.cuhk.edu.hk, Yiwei Wang

We propose an importance-sampling based method to obtain an unbiased simulator to evaluate expectations involving random variables whose probability density functions are unknown while their Fourier transforms have an explicit form. This method can be applied effectively to Heston stochastic volatility model, high dimensional affine jump-diffusion model, and various Levy processes.

3 - Calibration of Stochastic Volatility Models: A Tikhonov Regularization Approach

Min Dai, Associate Professor, National University of Singapore, Department of Mathematics, Singapore, Singapore, matdm@nus.edu.sg, Xingye Yue, Ling Tang

We develop a Tikhonov regularization approach to calibrate stochastic volatility models. An efficient numerical algorithm is given. In contrast to existing literature, we do not assume that the stochastic volatility model has special structure, so our algorithm applies to calibration of general stochastic volatility models.

4 - Simulation-based Optimization Method for Consumption-investment with Proportional Transaction Costs

Zhen Liu, Assistant Professor, University of Minnesota at Twin Cities, 206 Church St., S.E., Minneapolis, MN, 55455, United States of America, zhenliu@umn.edu

We study the consumption-investment problem with proportional transaction costs over an infinite time horizon. Following Han and Van Roy (2011), we write the value function as the solution to an infinite-dimensional linear program, then approximate the value function by a nonlinear program, where the transaction costs are explicitly formulated as linear constraints.

■ WC02

Level 2 - Room 200B

Theoretical Nonlinear Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu

1 - Mixed Convexity and Optimization

Emre Tokgoz, Faculty - Lecturer, University of Oklahoma, 601 Elm Ave. Room 423, Norman, OK, 73019, United States of America, Emre.Tokgoz-1@ou.edu, Hillel Kumin

In this work mixed convexity of mixed variable functions and the corresponding mixed Hessian matrices will be introduced. In addition, mixed convexity and optimization results will be obtained. Several examples from telecommunication systems, inventory models, and management Science will be given as applications of the results obtained.

2 - A Variational Framework for Revenue Optimization and Demand Forecasting

Alexander Kushkuley, Oracle, 10 Van De Graaff Drive, Burlington, MA, United States of America, alex.kushkuley@oracle.com, Su-Ming Wu, Maria Wang

The problem of retailer revenue optimization is usually solved in a three step cycle of model formulation, parameter estimation and subsequent revenue functional maximization. We investigate a general variational framework that is well suited for all three stages of this cycle. In particular, a bootstrap methodology that combines optimization with parameter estimation into one "optimize/re-estimate" procedure is evaluated on real data samples.

3 - A Hierarchical Algorithm for the Planar Single-facility Location Routing Problem

Hasan Manzour, University of Oklahoma, 1013 East Brooks Ave., Apt. H, Norman, OK, 73071, United States of America, smh.manzour@ou.edu, Said Salhi, S. Ali Torabi

Location routing problem (LRP) is an important logistical problem that comprises two of the main logistical drivers namely facility location and vehicle routing. We focus on the planar single-facility LRP with Euclidean distance. A hierarchical heuristic-based method is put forward which continuously takes into account the information from the routing results while systematically improving the location using the end-points of the obtained routes.

■ WC03

Level 2 - Room 200C

Extended Formulations

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Daniel Dadush, New York University, 15 Washington Pl, Apt. 5N, New York, NY, 10003, United States of America, dndadush@gmail.com

1 - Common Information and Unique Disjointness

Sebastian Pokutta, Assistant Professor, Georgia Institute of Technology, Ferst Dr., Atlanta, GA, United States of America, sebastian.pokutta@me.com, Gabor Braun

Communication complexity and information theoretic approaches have been at the core of many recent lower bounds for extended formulations. A key problem is unique disjointness which is closely related to the extension complexity of the correlation polytope and the clique problem. We provide a new information-theoretic framework for lower bounding the nonnegative rank. Within this framework we present an (almost) optimal estimation of the nonnegative rank of the unique disjointness matrix.

2 - Forbidden Vertices

Gustavo Angulo, Georgia Tech, Atlanta, GA, United States of America, gangulo@gatech.edu, Shabbir Ahmed, Santanu Dey, Volker Kaibel

We introduce and study the forbidden-vertices problem. Given a polytope P and a subset V of its vertices, we want to understand the complexity of linear optimization on the subset of vertices of P that are not contained in V. We show that the complexity of the problem changes significantly depending on the encoding of P and/or V. We provide additional tractability results and extended formulations when P has binary vertices only.

3 - On the Existence of 0/1 Polytopes with High Semidenite Extension Complexity

Daniel Dadush, New York University, 15 Washington Pl, Apt. 5N, New York, NY, 10003, United States of America, dndadush@gmail.com, Sebastian Pokutta, Jop Briet

We show the existence of a n dimensional 0/1 polytope for which any spectrahedron projecting to it must be the affine slice of an (sub)-exponential sized PSD cone, i.e. there exists a 0/1 polytope with (sub)-exponential PSD extension complexity. This extends the result of Rothvoss 2011, which gave the result for linear extension complexity.

■ WC04

Level 2 - Room 200D

Optimization for Electric Energy Systems

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, xsun84@isye.gatech.edu

1 - Incentive Compatible Electricity Pricing via Robust Optimization

Joel Tay, Operations Research Center, Massachusetts Institute of Technology, Bldg. E40-149, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, joeltay@mit.edu, Dimitris Bertsimas

We consider the problem of maximizing total welfare for the day-ahead electricity market from the perspective of an Independent System Operator. The current pricing scheme in the market is a uniform-price auction that does not lead to Incentive Compatibility. We propose an efficient algorithm that implements Incentive Compatibility via robust optimization, and present computational results.

2 - Robust Optimal Demand Response

Andy Sun, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, Atlanta, GA, 30332, United States of America, xsun84@isye.gatech.edu, Shijie Deng

In this talk, we present a robust optimization framework for the portfolio management problem of a demand response aggregator. We first propose deterministic models in both continuous time and discrete time. Then, we propose robust optimization models which account for various uncertainties in the demand response events. Numerical results will be presented.

3 - Robust Security-constrained Unit Commitment with Dynamic Ratings

Anna Danandeh, University of South Florida, Tampa, FL, 33620, United States of America, annadanandeh@mail.usf.edu, Bo Zeng

The actual capacity of overhead transmission lines and gas generators vary by their ambient temperatures. To provide efficient and also reliable generation and dispatch decisions, we develop a two stage robust unit commitment formulation considering both dynamic line and generation ratings, subject to the uncertainty in weather conditions. Our model is demonstrated on standard IEEE testbeds as well as real industrial data.

■ WC05

Level 2 - Room 200E

Nonlinear Risk-averse Stochastic Programming

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Pavlo Krokhmal, University of Iowa, 3131 Seamans Center, Iowa City, IA, 52242, United States of America, krokhmal@engineering.uiowa.edu

1 - Stochastic Programming with Log-exponential Convex Measures of Risk

Alexander Vinel, University of Iowa, 3131 Seamans Center, Iowa City, IA, 52242, United States of America, alexander-vinel@uiowa.edu, Pavlo Krokhmal

We aim to address the problem of decision-making under uncertainty in the case of heavy-tailed distributions of losses. In our study we introduce a family of risk measures, which we call log-exponential risk measures, and show that they posses important methodological properties, such as convexity. We expect, that the introduced measures may be suitable to model risk-averse decision making in the presence of catastrophic risk, and our case study with real-life data showed promising results.

2 - A Scenario Decomposition Approach for Solving Optimization Problems with Coherent Risk Measures

Maciej Rysz, University of Iowa, 751 W. Benton St. Apt. 23, Iowa City, IA, 52242, United States of America, maciej-rysz@uiowa.edu, Pavlo Krokhmal

We consider large-scale portfolio optimization problems involving higher-moment coherent risk measures. An efficient solution algorithm for decomposing non-redundant scenarios by solving a series of relaxation problems containing linear combinations of scenarios is proposed. Numerical case studies demonstrating significant improvements in computation time are presented.

3 - Stochastic Optimization of Sensor Placement for Diver Detection

Michael Zabarankin, Associate Professor, Stevens Institute of Technology, Hoboken, NJ, United States of America, mzabaran@stevens.edu, Anton Molyboha

A comprehensive framework for diver detection by a sensor network in an urban harbor is presented. For each detection period, sensor outputs are aggregated into a linear statistic, whose coefficients and detection threshold are optimized for each noise scenario. On a short time scale, the serial dependence of sensor outputs is modeled by a hidden Markov chain, and optimal sensor placement is formulated as a two-stage stochastic optimization problem with respect to different noise scenarios.

■ WC06

Level 2 - Room 200F

Data-driven Network Models

Sponsor: Optimization/Networks

Sponsored Session

Chair: Alexander Gutfraind, University of Illinois at Chicago, 1603 W. Taylor Street Rm. 834, Chicago, IL, 60612, United States of America, agutfraind.research@gmail.com

1 - Generation of Realistic Networks by Multi-scale Perturbations

Alexander Gutfraind, University of Illinois at Chicago, 1603 W. Taylor Street Rm. 834, Chicago, IL, 60612, United States of America, agutfraind.research@gmail.com, Lauren A. Meyers, Ilya Safro

Many computational problems require synthetic networks with realistic properties. I will introduce a novel open source package for network generation termed MUSKETEER. It constructs new networks starting from a template, which is processed through a cycle of multiscale mappings, while receiving large perturbations to its structure. The generated "replicas" exhibit realistic structural, global and emergent properties, including clustering, assortativity, average distance and cascade size.

2 - Forming Effective Teams using Machine Learning and Optimization

Alexandros Nathan, Northwestern University, 1930 Ridge Avenue Apt. C204, Evanston, IL, 60201, United States of America, anathan@u.northwestern.edu, Sanjay Mehrotra, Noshir Contractor

As many disciplines in today's world are becoming team-oriented, the assembly of effective teams has become an increasingly important task. We are proposing a data driven optimization model for the assignment of individuals to teams with the objective of maximizing the quality of the weakest group. The model is utilizing the results of recent Social Networks research in the elements of successful teams, such as personality traits of individuals and trust between members of the same team.

3 - Expert Communication Networks for Market Change Predictions

Daniel Romero, Northwestern University, 600 Foster Street, Evanston, IL, United States of America, d-romero@kellogg.northwestern.edu, Brian Uzzi

Research on public social media as heralds of critical events has rapidly accelerated. We conduct tests to examine whether public and private social network data provide precursor signals for system behavior. Focusing on a large social system, financial markets, we examined 22 million instant messages among 8,828 persons in a network of financial specialists. We find that the social network provides unique precursor signals of system behavior - changes in the Dow Jones Industrial Average.

4 - Speeding Up Network Simulations using Discrete Time

Benjamin Armbruster, Northwestern University, 3242145 Sheridan Road, Evanston, Il, United States of America, armbruster@northwestern.edu

Network simulation models are becoming common for modeling the spread of infections. However, speed is often an issue for large populations. Choosing a discrete time simulation (DTS) over a discrete event simulation (DES) helps to remedy this problem at the cost some accuracy. We analyze and quantify the loss in accuracy for the common SI and SIS processes. Specifically we prove the DTS method for both processes converges with strong order 1, similar to Milstein's method for SDEs.

■ WC07

Level 2 - Room 200G

Simulation and Optimization of Stochastic Decision Processes

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Suvrajeet Sen, Professor, University of Southern California, Daniel J. Epstein Department of ISE, Los Angeles, CA, 90089, United States of America, S.sen@USC.edu

1 - Sampling within Algorithmic Recursions

Raghu Pasupathy, Associate Professor, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, pasupath@vt.edu, Fatemeh Hashemi, Soumyadip Ghosh

We consider the context of algorithmic recursions that involve quantities that need to be estimated using simulation. Our prototypical example is a trust-region type method adapted to solve simulation optimization problems, where function values at each step are replaced by function estimates obtained through Monte Carlo sampling. Within such contexts, we trade-off the deterministic error due to recursion with the "stochastic" error due to sampling.

2 - Information Relaxation and Dual Formulation of Controlled Markov Diffusions

Enlu Zhou, Assistant Professor, University of Illinois at Urbana-Champaign, 201D Transportation Bldg., 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, enluzhou@illinois.edu, Fan Ye

Information relaxation and duality in Markov decision processes (MDPs) have been studied recently. We extend this dual formulation to controlled Markov diffusions: in a similar way we relax the constraint of adapted policy and impose penalty on early access of the future information. We establish the weak and strong duality, and complementary slackness results. We explore the structure of the optimal penalties and expose its connection between MDPs and controlled Markov diffusions.

3 - Simulation for Optimization of Stochastic Decision Processes

Suvrajeet Sen, Professor, University of Southern California, Daniel J. Epstein Department of ISE, Los Angeles, CA, 90089, United States of America, S.sen@USC.edu, Harsha Gangammanvar

In contrast to simulation optimization, we consider the process of simulation for the purposes of optimizing stochastic decision processes. Motivated by the success of stochastic decomposition for two-stage stochastic programs, we present an optimization algorithm in which simulation concepts (initialization bias, sampling, bootstrapping etc.) are coupled with optimization concepts (decomposition, approximation, and regularization) to address sequential decision problems.

■ WC08

Level 2 - Room 200H

Computation in Healthcare

Sponsor: Computing Society

Sponsored Session

Chair: Nedialko Dimitrov, Naval Postgraduate School, 1411 Cunningham Road, Monterey, CA, 93943, United States of America, ned@nps.edu

1 - Application of Derivative-free Optimization to Influenza Epidemic Vaccination

Judy Chen, Carnegie Mellon University, 5000 Forbes Avenue, DH A103, Pittsburgh, PA, 15213, United States of America, judyc@andrew.cmu.edu

Vaccination is the principal strategy to reduce the morbidity and mortality caused by the influenza virus. In this work, a derivative-free optimization method is used in combination with an epidemic simulator to study and optimize the vaccination strategy under limited vaccine supply.

2 - Solution Approaches for the Load Leveling Appointment Scheduling

Azadeh Mobasher, Science Analyst, Manhattan Associates, 2300 Windy Ridge Pkwy SE, Atlanta, GA, 30339, United States of America, azadeh.mobasher@gmail.com, Elham Mortazavi, Maryam Aliakbari

Appointment scheduling for the patients of surgical physicians in a cancer center is a complex problem due to the limited available clinical time of physicians and the unexpected long hours of surgeries. These complexities result in pushing appointments to limited days of a week (unbalanced schedule). In Load Leveling Appointment Scheduling Problem, we try to determine the balanced schedule of appointments for surgical physicians and to satisfy the preferences of physicians and patients.

3 - Sawmill Production Planning – A Comparison of Different Optimization Models with Simple Heuristics

Maria Anna Huka, University of Natural Resources and Life Sciences, Vienna - Department of Economics and Social Sciences - Institute of Production and Logistics, Feistmantelstrasse 4, Vienna, AT, 1180, Austria, maria.huka@boku.ac.at, Manfred Gronalt

The short term multi-period sawmill production planning problem is formulated as a MIP model. We compare different modelling approaches and consider both a profit margin and cost oriented objective function. The results of a multi-period planning problem are again compared to the solutions of simple heuristics applied by plant managers. We develop new heuristics and show their performance compared to an optimization approach.

4 - A Novel Framework for Beam Angle Optimization in Radiation Therapy

Hamed Yarmand, Postdoctoral Research Fellow, Massachusetts General Hospital and Harvard Medical School, Francis H. Burr Proton Therapy Center, 30 Fruit Street, Boston, MA, 02114, United States of America, yarmand.hamed@mgh.harvard.edu, David Craft

Two important elements of a radiation therapy treatment plan are quality (measured based on the target coverage and dose to organs at risk (OARs)) and delivery time, heavily depending on the number of beams. We use the dose to OARs in the ideal plan, which uses all candidate beams, to find the plan with the minimum number of beams and a predetermined maximum deviation from the ideal plan. We use mixed integer programming (MIP) for optimization and two heuristics to reduce the computation time.

■ WC09

Level 2 - Room 200I

Improving Security via Analytics

Sponsor: Analytics Section

Sponsored Session

Chair: Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Department, 800 N State College Blvd, Fullerton, CA, 92831, United States of America, smitra@exchange.fullerton.edu

1 - Behavioral Security for financial Institutions ATMs using Big Data Analytics

Arif Ansari, Associate Professor of Clinical IOM, University of Southern California, 3670 Trousdale Parkway, BRI 40R, Los Angeles, CA, 92336, United States of America, aansari@usc.edu

ATM frauds have increased across the globe and in size; these massive frauds involve stolen cards with software tampering of ATM networks to increase the daily limit, followed by withdrawal of currency using cashing crews. By adding behavior based second layer of authentication we can easily detect and prevent massive simultaneous ATM frauds. Leveraging Big Data, we propose innovative non-interfering, intuitive, adaptive Behavioral security that will prevent massive ATM fraud.

2 - Taking Back Control of your Identity Certification: An Alternative to Traditional Credentials

John H. Gerdes, Associate Professor, University of South Carolina, 1301 Gervais Street, Suite 1010, Columbia, SC, 29201, United States of America, JGgerdes@sc.edu

Dossiers can be created by using personal identifiers to link records from independent information systems. We discuss a new class of digital certificate (veiled certificates) that prevent this linkage, yet uniquely identifies individual, satisfying reporting requirements. We illustrate how to incorporate biometrics to protect against user's misuse of credentials, and still maintain credential's desirable non-linkability property. Implications and directions for future research are discussed.

3 - Law Enforcement Analytics is not Ready

Rahul Bhaskar, California State University, Fullerton, Fullerton, CA, United States of America, rbhaskar@fullerton.edu

We analyzed the status of fusion center and found that they are not using anlaytics to its fullest extent.

4 - The Role of Statistical Model-based Analytics in Biometric Authentication

Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Department, 800 N State College Blvd, Fullerton, CA, 92831, United States of America, smitra@exchange.fullerton.edu

The use of biometric traits for security purposes is quite widespread today, from immigration and border control to access control in electronics, ATMS and e-commerce transactions. In this talk, I will point out some statistical issues underlying the method of biometric authentication that substantiate the need for detailed analytics, and briefly present a model-based approach for better performance evaluation of biometric systems. I will illustrate this with the help of a face biometric system.

■ WC11

Level 2 - Room 201A

Pricing, Inventory and Sales Management

Contributed Session

Chair: Alireza Kabirian, California State University Northridge, 18111 Nordhoff St., Northridge, Ca, 91303, United States of America, akabirian@csun.edu

1 - Pricing Data Elements with the Use of Shapley Value

Irina Romochkina, PhD Candidate, Rotterdam School of Management, Erasmus University Rotterdam, Burgemeester Oudlaan, 50, Rotterdam, 3062PA, Netherlands, iromochkina@rsm.nl, Rob Zuidwijk

Inter-organizational coordination hubs are widely used within the container transportation industry. They facilitate tracking cargo, coordinating terminal visits etc. The current pricing model for the services of such hubs accounts for the investment of information infrastructure providers but not for the value of the data that other companies are contributing to make the service function. This paper develops a pricing model that takes this into account using the Shapley value concept.

2 - Fuel Surcharge Pricing: Theory and Practice

Ryan Choi, University of California, Irvine, 335 SB, UCI, Irvine, CA, 92697, United States of America, jihungc@uci.edu

There is suspicion that truck carriers use fuel surcharges to make profits above and beyond the cost of fuel. We analyze how well the formula for fuel surcharges widely used in the transportation industry mirrors truck carriers' fuel cost changes. The analysis shows that, under certain conditions, fuel surcharges increase faster than changes in base freight prices and suggests that fuel surcharges may be used by truck carriers for profit making.

3 - An Inventory Model for Supply Chains with Price and Stock Dependent Demand

Zaman Forootan, PhD Candidate, University of Calgary, 2500 University Dr. NW, Calgary, AB, T2N1N4, Canada, m.z.forootan@haskayne.ucalgary.ca, Jaydeep Balakrishnan, Van Enns

In a competitive market, managers should follow changes in customers' buying behavior by adjusting factors such as product price and availability. This research targets decision-making parameters in pricing and replenishing a product that would benefit the overall supply chain with price- and stock- sensitive demand and finds the optimal strategy for joint pricing and replenishment. The results provide answers to when and how much the price should change, and how that affects the ordering policy.

■ WC12

Level 2 - Room 201B

Financial Risk and Operations Management

Contributed Session

Chair: Jonathan Crook, Professor, Credit Research Centre, University of Edinburgh, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, j.crook@ed.ac.uk

1 - Development and Evaluation of an Investment Algorithm Based on Markowitz's Portfolio Selection Model

Jaeho Choi, Yonsei University, Sinchon-dong, Seodaemun-gu, Seoul, Korea, Seoul, Korea, Republic of, hojich@gmail.com, Jongbin Jung, Seongmoon Kim

This paper develops an investment algorithm based on Markowitz's Portfolio Selection Theory, and empirically evaluates the performance of the proposed algorithm in the U.S. and the Hong Kong stock markets. During the 6-year investment, growth rates of 12.63% and 23.25% were observed for Dow Jones Industrial Average and Hang Seng Index, respectively, while the proposed investment algorithm achieved cumulative returns of 35.7% in the U.S. stock market, and 150.62% in the Hong Kong stock market.

2 - Improving Value Assessment in High-volatility Oil & Gas Firms

Sebastien Casault, PhD Candidate, University of Twente, 403-545 18 Ave. SW, Calgary, AB, T2S 0C6, Canada, sebcasault@gmail.com, Aard J. Groen, Jonathan D. Linton

A "thick tailed" power law distribution more accurately describes the behavior of the value of Oil & Gas (O&G) firms than the typical Gaussian approach. Current models assume that commercial returns from these firms are described by a normal random walk. This leads to an undervaluation of these firms and eliminates the possibility of drastic changes resulting from gas discoveries, for example. Our empirical data show that O&G firms are statistically more valuable than other Gaussian investments.

3 - Repayment Patterns to Aid Write-off Decisions in the Collections Process

Anna Matuszyk, Assisstant Professor, Warsaw School of Economics, Al. Niepodleglosci 162, Warsaw, 02-554, Poland, amatuszyk@matuszyk.com, Lyn Thomas, Meechi So, Angela Moore

The recovered amount depends on the willingness and capacity to pay of the debtor but also on the lender's actions. Among these is the decision of when to write off the debt and to stop pursuing the debtor because the costs exceed the expected amount that will be repaid. Building a model of how the various repayment patterns occur allows one to estimate how much of the debt is likely to be repaid and shows what impact different write-off strategies would have on the average recovery rate.

4 - A Two-stage Mixture Model for Estimating EAD for Revolving Credit

Jonathan Crook, Professor, Credit Research Centre, University of Edinburgh, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, j.crook@ed.ac.uk, Mindy Leow

Using a large portfolio of defaulted loans we estimate EAD for an obligor. We develop a discrete-time repeated events survival model to predict for the probability of an account having a balance greater than its limit. The final prediction for balance is the sum of the expected balance and expected limit, depending on how likely the borrower is to have a balance greater than the limit. We thus predict expected balance at any time point.

■ WC13

Level 2 - Room 202A

Homeland Security

Contributed Session

Chair: Fuat Kosanoglu, Phd Student, University of Wisconsin- Madison, 1415 Engineering Drive, Room 3237, Madison, WI, 53705, United States of America, kosanoglu@wisc.edu

1 - Assessing the Value of Social Media Data for Biosurveillance

Kristina Howard, Project Manager, BVTI, BVTI, 15855 Parnell Ct, Haymarket, VA, 20169, United States of America, kristina.howard@associates.hq.dhs.gov, Julie Waters, Steve Bennett

Much attention has been given recently to the purported ability of social media to provide early warning and/or ongoing situational awareness and event characterization during a biological event of national concern. This presentation will highlight ongoing activities at the National Biosurveillance Integration Center (NBIC) to evaluate the utility of social media informatics data for biosurveillance, including ontologies/taxonomies, machine learning approaches, and automated alerts.

2 - Analytics in Action at the NYPD's Counterterrorism Bureau

Evan Levine, Intelligence Research Manager, NYPD, One Police Plaza, Room 1109, New York, NY, 10038, United States of America, evan.levine@nypd.org

The NYPD's Lower Manhattan Security Coordination Center integrates data from a variety of different sensors and databases for the primary purpose of countering terrorism. These data streams have necessitated the development of analytic processes to prioritize data for officer attention. I will discuss the structure of these processes and the lessons we have learned in their development.

3 - A Cyber Resilience Recovery Model for Support Mission Capability and Sustainability

Hiep Tran, PhD Candidate, George Washington University, Washington, DC, United States of America, hdtran@gwu.edu, Enrique Campos-Nanez, Pavel Fomin, James Wasek

This presentation introduces a system dynamics model of the resilience recovery process following a cyber-attack against computer network. The model provides insight into the effectiveness of the current recovery process. It also provides solutions to meet changing cyber security threats. This model can be used for decision support and investment strategies to support mission capability and sustainability. It can be calibrated using mission and organization specific data.

4 - Target-Oriented Utility for Interdiction of Transportation Networks

Fuat Kosanoglu, Phd Student, University of Wisconsin- Madison, 1415 Engineering Drive, Room 3237, Madison, WI, 53705, United States of America, kosanoglu@wisc.edu, Vicki Bier

We study optimal resource allocation for cost-effective protection of transportation networks, using target-oriented utility theory and mixed-integer programming to determine the optimal level of investment needed to interdict an attacker on a transportation network. In particular, we consider optimal placement of detectors on a transportation network in order to reduce the success probability of an attack and deter attacks. We explore the effects of attacker behavior on the optimal defense.

■ WC14

Level 2 - Room 202B

Reverse Supply Chain Management

Contributed Session

Chair: Daniel Steeneck, Ph.D. Candidate, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, steeneck@vt.edu

1 - Sustainable Global Reverse Logistics Network Design for Household Plastic Waste Recycling

Xiaoyun Bing, PhD researcher, Top Institute Food and Nutrition, P.O.Box:8130, Wageningen, 6700 EW, Netherlands, xiaoyun.bing@wur.nl, Jack van der Vorst, Jacqueline Bloemhof, Amin Chaabane

Waste should be treated as a global resource. This paper aims to design an eco-efficient global reverse supply chain under emission restrictions with a multi-objective linear programing model, which minimizes cost and environmental impact. The model allocates intermediate processing facilities globally. A case study is conducted on household plastic waste. Result can provide valuable insights for global sustainable waste recycling from a global perspective.

2 - Environmental and Economic Buffer Allocation Problem in Sorting Disassembly System

Tetsuo Yamada, Associate Professor, The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo, 182-8585, Japan, tyamada@uec.ac.jp, Norihiro Itsubo, Yuto Okudera, Masato Inoue

This study discusses a multi criteria buffer allocation problem in a sorting disassembly system environmentally and economically, and evaluates the system performance in terms of not only collected rate and recycling cost but also recycling rate and collected CO2 volumes for integrating closed-loop and low-carbon supply chain for sustainability.

3 - Channel Selection in Recovery Logistics Network under Time-Value Consideration

Sung Ook Hwang, Texas A&M University, 3131 TAMU, College Station, 77840, United States of America, hwang1227@neo.tamu.edu, Daniel Guide, Halit Uster

We consider a channel selection problem in the presence of multiple return channels in a recovery logistics network. The problem is formulated as a linear program and time parameters are introduced to express product residual value over time. We present an analysis of channel selection strategies based on the characteristics of the products and the network.

4 - The Role of Market Process in Reverse Supply Chains for Durable Goods

Patrick O'Reilly, Ph.D. Candidate, Mineral and Energy Economics, Colorado School of Mines, PO Box 11, Golden, CO, 80402, United States of America, poreilly@mines.edu

Durable waste streams are typically modeled as stages of supply chain networks: special cases of company or government policy, rather than dynamic market processes. Although market processes are robust to many distortionary or less-profitable policies, few formulations reflect this robustness. Here we consider a network of salvage processes in durable goods recycling, as decentralized reverse supply chains whose agents optimize according to their knowledge of the particular time and place.

5 - Models for Production Planning and Product Design for the Reverse Supply Chain

Daniel Steeneck, Ph.D. Candidate, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, steeneck@vt.edu, Subhash Sarin

New models for both production planning and product design for the reverse supply chain will be presented. These models feature a) core supply for remanufacturing/salvage as an endogenous variable and b) determination of the end-of-life option (EOL) for the product. Modifications to the models will be presented to address variations of the problem. A mapping of product characteristics to optimal EOL option based on the models is presented along with product design strategies.

■ WC16

Level 2 - Room 204

Management of Blood Products

Sponsor: Health Applications

Sponsored Session

Chair: Alireza Sabouri, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, Alireza.Sabouri@sauder.ubc.ca

1 - Optimal Selection of Blood Screening Assays under Prevalence Uncertainty

Ebru Bish, Associate Professor, Virginia Tech, Dept of Industrial and Systems Engineeri, 250 Durham Hall, Blacksburg, VA, 24061-0118, United States of America, ebru@vt.edu, Prasanna Kumar Ragavan, Douglas Bish

Blood products are an essential component of any health system, and their safety, in terms of being free of transfusion-transmitted infections, is crucial. However, blood screening tests are imperfectly reliable and prevalence rates are uncertain. The budget-constrained decision-maker needs to select a set of screening tests so as to minimize the infection risk in the blood pool. We analyze structural properties of an optimal solution and perform a case study using real data.

2 - Issuing Policies for Hospital Blood Inventory

Alireza Sabouri, Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, Alireza.Sabouri@sauder.ubc.ca, Tim Huh, Steven Shechter

We propose a model for allocating red blood cells for transfusion to patients, which is motivated by recent evidence suggesting that transfusing older blood is associated with increased mortality rate. We study the properties of blood issuance policies that balance the trade-off between "quality" measured in average age of blood transfused and "efficiency" measured in the amount of shortage. Based on our analysis, we design efficient issuance policies and evaluate their performance.

3 - Integer Programming Models to Manage Hospital's Blood-products Inventory

Grisselle Centeno, Associate Professor, University of South Florida, 4202 East Fowler Avenue, ENB118, Tampa, FL, 33620, United States of America, gcenteno@usf.edu, Serkan Gunpinar

Reducing shortage and wastage is a major challenge in the management of blood products. We present stochastic and deterministic integer programming models to minimize the total cost, shortage and wastage levels at a hospital and explicitly consider age of blood inventory, uncertain demand rates and crossmatch-to-transfusion ratio. Results reflect significant reduction on wastage rates which decreased from 19.9% to 2.57% on average.

■ WC17

Level 2 - Room 205A

Green Science

Sponsor: Service Science

Sponsored Session

Chair: Saif Benjaafar, University of Minnesota, 111 Church St. SE, Minneapolis, MN, 55455, United States of America, saif@umn.edu

1 - Carbon Penalties and Supply Chain Emissions

Xi Chen, University of Minnesota, 111 Church St., SE, Minneapolis, MN, 55455, United States of America, chen1644@umn.edu, Saif Benjaafar

We study the impact of carbon penalties on firms' operations and the overall emissions of supply chains. Surprisingly, we show that imposing a penalty on the emissions of each firm can lead to higher overall supply chain emissions. We then explore how to devise emission penalty schemes to mitigate this adverse effect. Moreover, we show that a differentiated penalty is socially more desirable than a penalty that treats the emissions of all firms the same.

■ WC18

Level 2 - Room 205B

Dynamic Programming Applications

Contributed Session

Chair: Wanshan Zhu, Associate Professor, Tsinghua University, Department of Industrial Engineering, Shunde Building 613, Tsinghua University, Beijing, 100084, China, zhuws@umich.edu

1 - Using Approximate Dynamic Programming for Determining Production and Inventory Control Policies

Han Wu, Graduate Assistant, University of Louisville, 580 S Preston St., Louisville, KY, 40202, United States of America, h0wu0009@louisville.edu, Sunderesh Heragu, Gerald Evans

Assembly lines for dishwashers require multiple types of wire racks, which must be fabricated and coated at different work centers before supplying the assembly lines. A simulation model was built to represent the complex production system which has multiple working stages, multiple intermediate components and products. Approximate dynamic programming model was used to find a near optimal production and inventory control policy for the dishwasher wire rack production system.

2 - An Optimal Control Approach to Botnet Mitigation

Shaunak Dabadghao, Purdue University, 315 N Grant St., West Lafayette, IN, 47907, United States of America, sdabadgh@purdue.edu, Vaibhav Garg

Botnets are the underlying infrastructures that allow large scale cybercrime to exist. We consider an optimal control approach to mitigate botnets. The key state is number of infected computers and the two controls employed are Brute attack, taking the botnet servers down and a Cold attack, arresting the botnet master. The model is nonlinear and requires numerical techniques to find a solution. Steady states are studied and use of the two strategies during different states analyzed.

3 - Supplier's Multi-period Inventory Control Model with Resilience Constraint

Nobuyuki Ueno, Prefectural University of Hiroshima, 1-1-71 Ujinahigashi Minami-Ku, Hiroshima, Japan, ueno@pu-hiroshima.ac.jp, Koji Okuhara

We propose a model for a supplier' multi-period inventory control problem with resilience in automotive industries, where uncertain advance demand information called 'Naiji' is transmitted before manufacturing. It is formulated as a dynamic programming which minimizes the expected loss subject to production and resilience constraints. The characteristics of resilience constraint is explained and some numerical examples are shown to illustrate the availability of this model.

4 - Strategic Capacity Investment under Uncertainty

Kuno Huisman, Tilburg University, Post Office Box 90153, Tilburg, Netherlands, kuno.huisman@gmail.com, Peter Kort

This paper considers investment decisions within an uncertain dynamic and competitive framework. Each investment decision involves to determine the timing and the capacity level. We find that the first investor overinvests in capacity in order to delay entry of the second investor. In very uncertain economic environments the first investor always ends up being the largest firm in the market.

■ WC19

Level 2 - Room 205C

Matching Markets II

Sponsor: Applied Probability

Sponsored Session

Chair: Jacob Leshno, Microsoft Research, One Memorial Drive, Cambridge, MA, United States of America, jaleshno@microsoft.com

1 - Unbalanced Random Matching Markets

Jacob Leshno, Columbia University, New York, NY, United States of America, yarboz@gmail.com, Itai Ashlagi, Yashodhan Kanoria

We analyze random matching markets with unequal numbers of men and women. Being on the short side of the market confers a large advantage. If there are n men and n+1 women then whp in any stable matching, the men's average rank of their wives is no more than 3\log n, whereas the women's average rank of their husbands is at least n/(3\log n). If there are n men and (1+a)n women for a>0 then whp in any stable matching the men's average rank is O(1), and women's average rank is \Omega(n).

2 - Dynamic Matching Markets with an Application in Residential Real Estate

Hua Zheng, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, hzheng14@gsb.columbia.edu, Costis Maglaras, Ciamac Moallemi

We study a dynamic microstructure model of a dynamic market where buyers and sellers arrive stochastically over time, and are heterogeneous with respect to their product characteristics and preferences and their idiosyncratic financial information. We analyze its dynamics, market depth, and buyer/seller bidding strategies. The motivating application stems from residential real estate.

3 - On the Dynamic Control of Matching Queues

Itai Gurvich, Associate Professor, Northwestern University, 2001 Sheridan Road, Evanston, IL, United States of America, i-gurvich@kellogg.northwestern.edu, Amy Ward

We study the optimal control of matching queues with dynamically arriving jobs. The objective is to minimize cumulative holding costs over a finite time horizon. We introduce a multi-dimensional imbalance process that facilitates the construction of a lower bound. Imposing a match-pooling condition, we devise a discrete-review dynamic matching policy that asymptotically, as the arrival rates become large, achieves this imbalance-based lower bound.

4 - Dynamic Matching Markets with Search Friction

Nick Arnosti, Stanford University, Stanford, CA, United States of America, narnosti@stanford.edu, Yashodhan Kanoria, Ramesh Johari

It is often costly for agents in matching markets to determine whether potential partners are interested in forming a match. This creates friction in the marketplace, lowering welfare for all participants. We introduce a dynamic model that allows us to quantitatively study this effect. We demonstrate that simple interventions by the market operator (such as restricting applications or increasing the application cost) can dramatically benefit both sides of the market.

5 - Existence of Stable Matchings in Large Markets with Complementarities

Eduardo Azevedo, Assistant Professor, University of Pennsylvania, 3620 Locust Walk, Wharton School, SHDH 1400, Philadelphia, PA, 19104-6302, United States of America, eazevedo@wharton.upenn.edu

It is known that in matching markets the existence of a stable outcome can be guaranteed if and only if preferences are substitutable and contracts are bilateral. We show that, in markets with a continuum of each type of agent, it is only necessary that agents on one side of the market have substitutable preferences to guarantee the existence of a stable outcome. In addition, we show that, with general preferences, the core is nonempty, and that stable matchings always exist with transfers.

■ WC20

Level 2 - Room 205D

Revenue Management in Hospitality and Entertainment

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ori Marom, RSM Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, omarom@rsm.nl

1 - Regression Model Estimating Annual Hotel Revenue

Christopher Keller, Assistant Professor, College of Business, East Carolina University, Greenville, NC, 27854, United States of America, kellerc@ecu.edu

This research uses partial daily occupancy and rate data to construct a regression model for estimating future annual revenues in order to evaluate the purchase of a hotel property. This presentation considers a variety of alternative modeling assumptions to provide a robust sensitivity analysis for evaluation and ultimately negotiation.

2 - Forecasting and Pricing for Small and Medium Enterprise Hotels in the Netherlands

Dirk Sierag, CWI Amsterdam, Science Park 123, Amsterdam, 1098 XG, Netherlands, dirk@cwi.nl

Small and medium enterprise (SME) hotels face different forecasting and pricing challenges than big chain hotels, while most research is conducted on the latter. Therefore proper forecasting and pricing methods need to be developed for SME hotels. We use recent data of several Dutch SME hotels to explore the problems and opportunities for different types of hotels. Furthermore, different basic and advanced forecasting methods are applied to the data and the results are compared.

3 - Optimal Seat Offering for Entertainment and Sporting Events Revenue Management

Kyle Maclean, Western University, #1408 - 500 Ridout St., London, Canada, k.d.maclean@gmail.com

We model a problem faced by entertainment venues (Theatres/Sports Arenas). Consumers wish to be seated as a group, and if this is not possible, may not attend at all. Thus, management must decide which set of seats to offer an incoming consumer group to maximize the amount of groups that can be seated overall. We formulate the problem as a BIP and show via simulation that it outperforms other methods, including offering all available seats, and a heuristic.

4 - Revenue Management with Highly Influential Seller Recommendations: A Study of OTA Websites

Ori Marom, RSM Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062PA, Netherlands, omarom@rsm.nl, Roman Peskin

Online travel agents such as Orbitz often have tremendous power to direct online buyers to a small subset of available products. Our paper studies OTA selections of top-listed hotels. Over a period of 135 days we tracked price and OTA page-rank data for 2581 different hotels. Our analysis indicates that while OTA websites provide buyers with valuable search assistance by locating good-valued deals they also influence them to purchase relatively expensive products.

■ WC21

Level 2 - Room 206

Models and Analyses: Applications in Healthcare Engineering

Sponsor: Health Applications

Sponsored Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, amycohn@med.umich.edu

1 - Inferring the Transmission Tree during an Outbreak Investigation

Alexander Gutfraind, University of Illinois at Chicago, 1603 W. Taylor Street Rm. 834, MC 923, Chicago, Il, 60612, United States of America, agutfrai@uic.edu, Jaideep Ray, Richard Chen

During an outbreak of an infectious disease, public health authorities need to construct a transmission tree representing the chain of transmission starting with the "index case" that introduced the infection. We propose a novel and flexible MIP approach to solving this problem and demonstrate its performance on both synthetic and real instances.

2 - Effective Way to Generate Multiple Solutions for Medical Residents Scheduling

Young-Chae Hong, University of Michigan, Department of Industrial and Operations, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, hongyc@umich.edu, Ariella Rose, Micah Long, Amy Cohn, Elizabeth Perelstein

Given many rules and requirements, scheduling medical residents is a highly complicated task. Adding to this complexity, the objective function is ill-defined and multi-criteria. Instead of finding a unique optimal solution, our goal is to quickly find and present to the user a range of high-quality feasible solutions. We focus on the modeling of the problem and the algorithmic approach to generating multiple solutions.

3 - Using Stochastic Programming to Improve Service Quality in an Outpatient Infusion Center

Spyros Potiris, Graduate Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, spotiris@umich.edu, Christopher Friese, Autumn Heiney, Amy Cohn, Brian Denton

Demand for outpatient chemotherapy delivery is rising, resulting in high patient volumes at infusion centers. To reduce patient waiting times and operating hours, we developed a stochastic programming model and easy to implement heuristics to generate patient appointment times at an infusion center. Our models explicitly consider the uncertainty of patient infusion times. We also show a detailed discrete event simulation model to evaluate the performance of the new patient appointment schedules.

4 - Scheduling Residents to Achieve Adequate Training on Procedures with Random Occurrences

William Pozehl, University of Michigan, 1075 Beal Ave., Ann Arbor, MI, 48109, United States of America, pozewil@umich.edu, Rishindra Reddy, Amy Cohn, Mark Daskin, Ryan Chen, Andrea Obi, Jennifer Chung, Jacob Seagull

Residents have certification case requirements for a variety of procedures (e.g., heart transplants). Call schedules rotate on a regular basis. Procedure occurrences are random. All residents will not necessarily accrue enough cases even if the total number of cases exceeds the number of residents times the requirements per resident. We develop a simulation model of this problem and outline alternative scheduling rules that increase the number of residents who can be certified.

■ WC22

Level 2 - Room 207

Health Care IV: Scheduling II

Contributed Session

Chair: Berna Dengiz, Professor, Baskent University, Baglica Campus, Eskisehir Road 20th.km, Etimesgut, Ankara, 06530, Turkey, bdengiz@baskent.edu.tr

1 - A Convex Programming Approach to Appointment Scheduling Problem with Piecewise Linear Cost Function

Dongdong Ge, Shanghai University of Finance and Economics, 777 Guoding Road, Shnaghai, 200433, China, dongdong@gmail.com, Zizhuo Wang, Jiawei Zhang, Guohua Wan

This work is concerned with the problem of scheduling a set of jobs with predetermined order on a single processor to minimize the total cost incurred by jobs waiting and processor idling, where job processing times are discrete random. We prove optimality of integer solutions and develop a convex relaxation approach to solve the problem. We extend the analysis to a situation in which samples are available and develop a near-optimal solution algorithm.

2 - Modeling and Analysis of Indirect Patient Wait Time

Song Chew, Associate Professor, Southern Illinois University Edwardsville, Southern Illinois University Edwardsvill, Edwardsville, IL, 62026, United States of America, schew@siue.edu

Outpatient appointment scheduling has been an active field of research. However, most work is concerned with direct patient wait time in clinics. Little work has been conducted to address indirect patient wait time between the point when appointments are scheduled and the point when appointments are met. The objective of this paper is to model and analyze indirect patient wait time using the notion of queueing models with batch services.

3 - A Simulation-based Approach for Dynamic Multi-priority Patient Scheduling

Antoine Sauré, University of British Columbia, Sauder School of Business, 2053 Main Mall, Vancouver, BC, V6T 1Z2, Canada, antoine.saure@sauder.ubc.ca, Jonathan Patrick, Martin Puterman

We present a method to dynamically schedule patients with different priorities to a health care facility in advance of the service date. We model the patient scheduling problem as an MDP and describe a simulation-based algorithm for solving it. The algorithm is based on the use of a policy iteration framework, a post-decision state variable and a non-linear value function approximation. We compare the performance of the policies obtained through this algorithm to that of four other policies.

4 - A Simulation-based Patient Appointment Scheduling for Radiology Department

Berna Dengiz, Professor, Baskent University, Baglica Campus, Eskisehir Road 20th.km, Etimesgut, Ankara, 06530, Turkey, bdengiz@baskent.edu.tr, S Kerem Boylu, Muhtesem Agildere, Orhan Dengiz, Baris Zeybek, A Utku Hacioglu

This paper describes a detailed simulation model for the operation of the tomography unit in the Radiology Department.The methodology presented uses simulation modeling to determine an effective appointment schedule to maximize patient throughput and to reduce the time patients spend in this department. The simulation model enables not only to see the current bottlenecks of the system but also to investigate different scenarios in order to achieve better working conditions.

■ WC23

Level 2 - Room 208A

Demand Control Strategies (Dynamic Pricing) in Revenue Management I

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: So Yeon Chun, Assistant Professor, Georgetown University, Mcdonough School of Business, 37th and O Streets, N.W., Washington, DC, 20057, United States of America, sc1286@georgetown.edu

1 - Dynamic Pricing and Replenishment with Customer Upgrades

Oben Ceryan, Drexel University, LeBow College of Business, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, oceryan@drexel.edu, Ozge Sahin, Izak Duenyas

We study the impact of product upgrades on a firm's pricing and replenishment policies. We consider a multiple period, nested two-stage model where at each period, the firm first sets prices and replenishment levels, and then decides whether to upgrade any of the realized demand to a higher quality product. We characterize the structure of the optimal upgrade policy as well as the optimal pricing and replenishment policies.

2 - Dynamic Pricing with Patient Customers

Yan Liu, University of Minnesota, 111 Church St., ME L123, Industrial and Systems Engineering, Minneapolis, MN, 55455, United States of America, liux0984@umn.edu, William Cooper

We consider an infinite horizon dynamic pricing problem with patient customers. Each arriving customer will purchase a product immediately if the price is below his valuation. Otherwise, such a customer will wait a fixed number of time periods and purchase a product as soon as the price goes below his valuation. If price remains above his valuation, the customer will depart without making a purchase. We identify the structure of an optimal policy and discuss extensions.

3 - Behavior-driven Promotion Campaign Analytics

Wei Sun, Research Staff Member, IBM Watson, 1101 Kitchawan Rd., Yorktown, 10598, United States of America, sunw@us.ibm.com, Anshul Sheopuri, Pavankumar Murali

Promotion campaigns can be costly, and their performance must be understood and executed well to accomplish business goals. However, demand is highly dynamic, noisy and interrelated among a wide range of products. Given many business constraints (e.g., a finite campaign budget) and numerous marketing options, we propose a system to design more focused and behavior-driven campaigns by incorporating new sources of data such as such as customer sentiment, browsing history, social media etc.

4 - Optimal Dynamic Buy-it-now Pricing for Sponsored Search Advertising

Ying-Ju Chen, University of California-Berkeley, Department of Industrial Engineering, Berkeley, CA, United States of America, chen@ieor.berkeley.edu

Asian search engines have pervasively adopted the buy-it-now options for selling the positions to advertisers. These buy-it-now options allow the advertisers to prematurely end an auction to obtain the position and have swamped the underlying ascending auctions. We demonstrate the quality uncertainty due to the discrepancy between nominal and actual positions, and characterize the optimal dynamic buy-it-now pricing in this sponsored search business model.

■ WC24

Level 2 - Room 208B

Dynamic Pricing and Network Games

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Nicholas G. Hall, Ohio State University, 2100 Neil Avenue, 658 Fisher Hall, Columbus, OH, 43210-1144, United States of America, hall_33@fisher.osu.edu

1 - Dynamic Pricing and Demand Learning with Limited Price Experimentation

He Wang, Massachusetts Institute of Technology, Cambridge, MA, United States of America, wanghe@mit.edu, David Simchi-Levi, Alexander Weinstein

In a dynamic pricing problem where the demand function is unknown a priori, price experimentation can be used for demand learning, but in practice sellers are faced with business constraints that prevent them from conducting extensive experimentation. We consider a dynamic pricing model where the seller can only change price for a limited number of times during the sales window.

2 - Dynamic Pricing to Minimize Maximum Regret

Nicholas G. Hall, Ohio State University, 2100 Neil Avenue, 658 Fisher Hall, Columbus, OH, 43210-1144, United States of America, hall_33@fisher.osu.edu, Zhi-Long Chen, Hans Kellerer

We study a two period, single product problem where a decision maker prices inventory in two periods. The demand for the product is a stochastic, nonincreasing function of price with known upper and lower bounds. We minimize the maximum total regret over the two periods. Three different models are solved optimally by polynomial time algorithms using systems of linear inequalities. The results of a computational study provide robust managerial insights about effective pricing.

3 - A Dynamic Network Game for the Adoption of Technologies of Uncertain Value

Matt V. Leduc, Stanford University, Huang Engineering Center, 475 Via Ortega, Stanford, CA, 94305-4121, United States of America, mleduc@stanford.edu, Matthew O. Jackson, Ramesh Johari

We propose a class of dynamic network games to study the adoption of technologies of uncertain value. This value can be learned by experimenting or by free-riding on others' experimentation. For an important set of technologies, the often-used policy offering a price discount to early adopters is least efficient. We demonstrate that a referral incentive policy may cause both low and high-degree agents to experiment whereas middle-degree agents free-ride on the information they generate.

4 - A Potential Game Framework for Approximately Optimal Pricing in Heterogeneous Networks

Michael Padilla, Assistant Professor, Singapore University of Technology and Design, 20 Dover Drive, Singapore, 138682, Singapore, michael_padilla@sutd.edu.sg, Tony Quek, Liang Ze Wong

We consider the distributed allocation of resources in a heterogeneous network and introduce a dynamic pricing scheme which converts our game into a potential game whose potential function is the social welfare. This dynamic pricing scheme is approximated with a mechanism that assigns a fixed price to each resource, and learning algorithms are presented which allow agents to select resources. Computational studies show that the social welfare approaches 85% of a centrally computed optimum.

■ WC26

Level 2 - Room 208D

Facilities Planning I

Contributed Session

Chair: S. Gokhan Ozden, PhD Student, Auburn University, Shelby Center Room 3333, Auburn, AL, 36849, United States of America, sgo0002@auburn.edu

1 - Small is Beautiful: A Study on Compact Storage Systems

Nima Zaerpour, RSM Erasmus University, T10-46, Postbus 1738, Rotterdam, Netherlands, nzaerpour@rsm.nl

Warehouses are important nodes in supply chains. They decouple supply from demand. Warehouses are needed in densely populated areas while in these areas space has become short. Therefore, enterprises are moving toward new compact storage systems. In this study we propose a framework to help warehouse managers for decision making. This includes response time analysis of different system configurations, cost comparisons, and energy consumption and CO2 emission calculations.

2 - Dynamic Facility Layout at MicroPower Company

Clara Novoa, Associate Professor, Texas State University, 601 University Dr, San Marcos, TX, 78666, United States of America, cn17@txstate.edu, Nhi Mai

We present a dynamic integer programming model to choose facility layouts for MicroPower operations over the next three-years. The problem is modeled as a Quadratic Assignment Problem but a few additional constraints are added to represent the exact problem faced by MicroPower. The authors present a new formulation for the dynamic facility layout problem with relocation costs, linearize the feasible region for this formulation, and demonstrate it solves successfully under Risk Solver Platform.

3 - A Model Predictive Control Approach for Long Term Planning of Capacity Investments

Jose Mojica, Masters Student, Brigham Young University, CB 350, Brigham Young University, Provo, UT, 84602, United States of America, jlmojica@gmail.com, John Hedengren

Capacity expansion of a district heating network is studied to evaluate the investment decision timing and type of capacity expansion. The study finds the optimal investment schedule over a 30 year horizon with uncertainty in fuel prices and system dynamics. The problem is formulated as an optimal control problem in which an initial system configuration is modified by a "controller" that optimally applies control actions to drive the system from an initial state to an optimal state.

4 - Layout Optimization of Offshore Wind Farms using NURBs-Based Potential Field Surrogate Models

John Steuben, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, jsteuben@mymail.mines.edu, Cameron Turner

This work presents a new algorithm for optimizing the layouts of offshore wind farms. We use an efficient Non-Uniform Rational B-spline (NURBs) based surrogate model of wind data to efficiently compute the effects of turbulent wakes. An optimization approach based on artificial potential fields is used to model other design objectives such as water depth and soil/site quality. The results of this optimization are demonstrated by developing wind farm layouts for a hypothetical offshore wind farm.

5 - Modeling Dynamic Deployment in the Physical Internet-enabled Open Distribution Web

Helia Sohrabi, Pavillon Palasis-Prince, 2325, Rue de la Terrasse, Local 2516, Québec, G1V 0A6, Canada, helia.sohrabi.1@ulaval.ca, Benoit Montreuil

Physical Internet (Montreuil, 2011) enables an Open Distribution Web (ODW) in which distribution centers are openly available to be exploited by companies other than their owners. Products can be stored and dynamically deployed within ODW. A two-stage scenario based model for dynamic deployment within ODW is presented in this talk.

■ WC27

Level 2 - Room 209A

Inventory Management: Risk Management

Contributed Session

Chair: Wanrong Ju, PhD candidate, Erasmus University Rotterdam, Burgmeester Oudlaan 50, H8-23, Rotterdam, 3062PA, Netherlands, ju@ese.eur.nl

1 - The New Understandings of the Newsboy Problem

Jing-An Li, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, No. 55, Zhongguancun East Road, Beijing, 100190, China, ajli@amss.ac.cn

The newsboy problem is a fundamental building block for models of inventory management in the face of stochastic demand and single period. In this paper, we'll reconsider the newsboy problem and show our new understanding. And the simulation case will be available at http://www.scmgame.org for your reference.

2 - A Risk-averse Inventory Model with Fluctuating Purchasing Costs

Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonseidae-gil, Wonju, 220-710, Korea, Republic of, sungyongchoi@gmail.com

I study a dynamic risk-averse inventory model using additive utility functions. I also assume Markovian behavior of purchasing costs. For finite-time models, I first prove (joint) concavity of the model for each state and obtain a (modified) base-stock optimal policy. Then, I conduct comparative static analysis for model parameters and derive monotone properties to the optimal solutions. For infinite-time models as a limiting case, I show that stationary base-stock optimal policies exist.

3 - A New Heuristic for an Inventory System with Random Yield and Positive Lead Time

Wanrong Ju, PhD candidate, Erasmus University Rotterdam, Burgmeester Oudlaan 50, H8-23, Rotterdam, 3062PA, Netherlands, ju@ese.eur.nl, Jan-Kees van Ommeren, Adriana Gabor

We study an infinite horizon periodic-review model with a supplier. The supplier has a positive lead time and random yield which is assumed to be binomially distributed. We study a simple order-up-to heuristic and show that the problem can be simplified to a newsvendor with a key variable the steady-state distribution of which is found without any assumption on demand distribution. The performance of the heuristic is verified by comparing with the optimal policy derived from dynamic programming.

■ WC28

Level 2 - Room 209B

Simulation and Optimization

Contributed Session

Chair: Karoly Bozan, Kent State university, 800 E Summit St., Kent, OH, 44240, United States of America, kbozan1@kent.edu

1 - A Trust Region-based Algorithm for Continuous Optimization via Simulation

Nick Sahinidis, Swearingen Professor, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, sahinidis@cmu.edu, Scott J. Bury, Bikram Sharda, Satyajith Amaran

We introduce a new algorithm for solving continuous simulation optimization problems, where the idea is to use a nonparametric regression model locally, and embed it in an iterative trust-region framework with intermediate calls to a global optimizer. We discuss the algorithmic elements of our implementation, and demonstrate promising results, wherein we compare against several other approaches over a large test set under Gaussian noise conditions.

2 - Multi-period Stochastic Resource Planning - A Simulation-Optimization Approach using Scatter Search

Stanislaus Solomon, University of Missouri-St. Louis, 236 Express Scripts Hall, 1 University Blvd, St. Louis, MO, 63121, United States of America, stan.umsl@gmail.com, Haitao Li

A key problem in the service setting is that of resource allocation. The complexity of the problem increases when resources have to be dynamically allocated over multiple time periods in the presence of uncertainty. Deterministic methods ignore the impact of uncertainty & rely on mean estimates of the random parameters. In order to account for uncertainty, we implement a simulation-optimization framework using the scatter search metaheuristic & Monte-Carlo simulation. A case study is presented.

3 - A Hybrid Optimization-simulation Modeling Approach for Stochastic Disassembly Line Balancing

Tevhide Altekin, Assistant Professor, Sabanci School of Management, Sabanci Universisty School of Management, Orhanli, Tuzla, Istanbul, 34956, Turkey, altekin@sabanciUniversityedu

The stochastic disassembly line balancing problem seeks a feasible assignment of tasks with stochastic task times to stations and involves incompletions when the work content of a station is not completed within cycle time. We assume normally distributed task times and the objective is to maximize expected disassembly profit. A hybrid optimization-simulation modeling approach that iteratively uses a MIP model and simulation is proposed. The results of our computational study are also presented.

4 - Performance Evaluation of Material Flow System in a JIT system

Adalet Oner, Asst.Professor, Yasar University, Agacliyol No:35, Bornova, Izmir, 35100, Turkey, adalet.oner@yasar.edu.tr, Gulce Hergul

This study concerns with the materials flow operations in a facility which produces wiring harnesses for car producers. The WIP leads are fed to assembly lines by a team called transporters. They collect required lead sheaves from WIP inventory area and move them to the material feeding stations around assembly lines. The objective is to increase efficiency of material transfer operations. A simulation model is developed to analyze and evaluate the current and proposed arrangements of operations

5 - Refrigerated Cargo Unloading Queue Optimization Simulation

Karoly Bozan, Kent State university, 800 E Summit St., Kent, OH, 44240, United States of America, kbozan1@kent.edu

Since time has turned into a strategic resource, process reengineering is required to gain competitive advantage and to increase productivity. Queuing refrigerated trucks while waiting for unloading is not only identified as lost time and productivity, but also as potential source of pollution and increased engine wear due to the running engine in the queue. This study aims to simulate refrigerated cargo unloading scenarios in a mixed cargo warehouse environment and recommend best practices.

■ WC29

Level 2 - Room 210A

Technology Management

Contributed Session

Chair: Pooya Soltantabar, Shahid Beheshti University, No 68- Mostowfi Ave. - Yousefabad, Tehran, Iran, p.soltantabar@mail.sbu.ac.ir

1 - Aviation 1945 >? Medicine 2005

Roger Bohn, Professor, University of California San Diego, IRPS MS 0519, La Jolla, CA, 92093-0519, United States of America, Rbohn@ucsd.edu

Aviation invented Standard Procedure Flying in 1937 and it was taught to all US pilots by end of WW2. We quantify formalization of flying procedures and explicit aviation knowledge. In comparison standard procedures in medicine today are below 1945 aviation level. But actual aviation use lagged explicit knowledge. US Navy pilots continued to "learn by doing, or dying" until jet aircraft in 1960s made this too expensive. We speculate on the implications for medicine.

2 - A Casual Framework for Supplier-buyer Alliance Capability, Alliance Willingness and Performance

Yu Chao, Assistant Professor, Chung Hua University, 707, Sec. 2, Wu Fu Road, Hsinchu, 30012, Taiwan - ROC, yc@chu.edu.tw

To sustain the relationship with key partners in High-Tech industries is more critical in dramatic change era. The author proposed a casual framework for supplier-buyer alliance capability, alliance willingness and performance in this study to try to explore the relationships between these four variables. From the framework we could find the relationship quality is an important mediate variable between supplier-buyer alliance capability, willingness to continue alliance and alliance performance.

3 - Analysis on Policy Implementation of Science and Technology Based on Content Analysis

Xia Wang, Professor, School of Economic and Management, Tongji University, French Center A403, Shanghai, China, xinzh0607@gmail.com, Lin Su, Li Xue, Bing Guo

The study of technology policies was usually focused on formulation and assessment, while the implementation analysis was ignored. This thesis, based on content analysis and quantifying study of qualitative information, studied the survey to 315 enterprises conducted by the Shanghai Development and Reform Commission in 2010, and analyzed the implementation of technology policies under grounded theory and led to three conclusions.

4 - An Investigation into Platforms for Implementation of Customer Relationship Management (CRM) in Iran

Pooya Soltantabar, Shahid Beheshti University, No 68- Mostowfi Ave. - Yousefabad, Tehran, Iran, p.soltantabar@mail.sbu.ac.ir, Ebrahim Jafari

CRM is one of modern technologies that plays role in having committed clienteles. Failure will be expected for any organization without having appropriate effort for implementation.The platforms of CRM have been explored according to Gartner's model.The important factors in implementation of CRM been characterized in Iranian hotel-keeping industry .In general it can be said that Iranian hotel-keeping industry is able to execute CRM successfully by taking some duly measures.

■ WC30

Level 2 - Room 210B

Integer Programming Applications I

Contributed Session

Chair: Andrea Tramontani, IBM Italy, CPLEX Optimization, Via Martin Luther King 38/2, Bologna, 40132, Italy, andrea.tramontani@it.ibm.com

1 - Lift-and-Project Cuts in CPLEX 12.5.1

Andrea Tramontani, IBM Italy, CPLEX Optimization, Via Martin Luther King 38/2, Bologna, 40132, Italy, andrea.tramontani@it.ibm.com

Lift-and-Project cuts are a well known class of inequalities for Mixed Integer Programming that has been shown to be computationally effective in the nineties by Balas, Ceria and Cornuejols. These cuts are now available in IBM ILOG Cplex Optimization Studio 12.5.1. In this talk we illustrate some details about the Cplex implementation of Lift-and-Project cuts, we provide benchmark results that show their performance impact, and we discuss some practical open questions still under investigation.

2 - A Heuristic Algorithm to Optimize the Deployment of RFID Readers for Object Locating

Lin Tang, PHD Candidate, Tsinghua University, Department of Industrial Engineering, Room 615, Shunde Building, Beijing, 100084, China, tl.ltang@gmail.com, Hui Cao, Li Zheng, Ningjian Huang

An integer programming model is proposed for object locating in manufacturing considering the balance of location accuracy and cost. It determines the optimal number and location of RFID readers satisfying a given accuracy. A genetic algorithm embedding with a divide-and-conquer heuristic algorithm is developed to solve the problem. The algorithm has a robust and efficient performance in terms of the solution quality and the computation time compared with two previous available methods,.

3 - A Study of the Robustness of the Electoral District for the Population Movement

Keisuke Hotta, Bunkyo University, 1100 Namegaya, Chigasaki, Kanagawa, 2538550, Japan, khotta@shonan.bunkyo.ac.jp

The electoral redistricting problem can be solved by 0-1 IP model and some idea. The optimal district shows the limit of the disparity between values of votes in different constituencies. The gap has been expanding year after year because of the population movement. By the optimization and the enumeration for the problem under the current population and the projected population, the robust district is obtained for the decision support.

WC31

Level 2 - Room 211A

Portfolio Optimization and Healthcare Finance

Sponsor: Financial Services

Sponsored Session

Chair: Wendy Roth, Georgia State University, 1043 College of Business, Atlanta, GA, United States of America, wroth@gsu.edu

1 - Robust Capital Investment Decisions of Nonprofit Healthcare Organizations

Shuyi Wang, Lehigh University, 217 W. Packer Ave. Apt. 209, Bethlehem, PA, 18015, United States of America, shw210@lehigh.edu, Aurelie Thiele

This study focuses on capital investment decisions of nonprofit healthcare organizations, such as buying a MRI machine. Instead of using a single monetary metric (Total Net Present Value) combining NPV and social value, we consider social value separately in a non-monetary but quantitative way, such as gain in expected quality-of-life years. We then analyze trade-offs between NPV and social outputs in the context of sustainable nonprofits.

2 - Portfolio Risk Management with Moment Matching Approach

Elcin Cetinkaya, Doctoral Student, Lehigh University, 200 West Packer Avenue Unit 12, Bethlehem, PA, 18015, United States of America, elc209@lehigh.edu, Aurelie Thiele

We investigate the problem minimizing the probability of obtaining a portfolio return less than a threshold while keeping the expected portfolio return no worse than a target. We propose a tractable solution involving an algorithm based on log-Normally distributed stock returns assumption and the Fenton-Wilkinson approximation method to the problem difficult to solve using exact methods. We compare its performance to that of some benchmark methods. We extend our approach to design basket options

3 - Risk Adjustment in Health Insurance

Tengjiao Xiao, Lehigh University, 200 W Packer Ave., Bethlehem, PA, 18015, United States of America, tex209@lehigh.edu, Aurelie Thiele

This paper introduces robust optimization models to address uncertainty in risk adjustment, which is used to quantify payment transfers across health plans. We develop robust scoring mechanisms at both individual level and aggregate level, investigate the usefulness of having ranges of risk scores instead of a single risk score, and test the impact of the time horizons involved. Learning is also incorporated in the risk adjustment models as more information becomes available over time.

4 - Robust Manager Allocation for Investment Management

Yang Dong, Student, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, yad210@lehigh.edu, Aurelie Thiele

A key difficulty for an investment manager is to quantify fund managers' skill when he may not know managers' allocation precisely. We propose a portfolio optimization framework that takes into account the uncertainty in fund allocation and consider both a robust optimization approach and a stochastic perspective. We then provide insights into the impact of the uncertainty related to the asset allocation and the asset returns on portfolio performance and the manager selection policy.

WC32

Level 2 - Room 211B

Miscellaneous Topics in Technology Management

Sponsor: Technology Management

Sponsored Session

Chair: Leonardo Santiago, Associate Professor, Federal University of Minas Gerais, Escola de Engenharia da UFMG, Av. AntÙnio Carlos, 6627 - Pampulha, Belo Horizonte, MG, 31270-901, Brazil, lsantiago@ufmg.br

1 - Strategic Buckets, Strategic Alignment, and the R&D Portfolio

Leonardo Santiago, Associate Professor, Federal University of Minas Gerais, Escola de Engenharia da UFMG, Av. Antònio Carlos, 6627 - Pampulha, Belo Horizonte, MG, 31270-901, Brazil, lsantiago@ufmg.br, Veronica Soares

Our work aims to offer operational guidelines to the strategic buckets formation. Motivated by a major literature review and an in-depth case research, we further investigate how seven majors innovative companies structure their R&D portfolio. We then propose a framework that incorporates the key strategic dimensions that can define the formation of the buckets.

2 - Metrics to Assess and Manage Computer Network Security Technologies

Soumyo Moitra, Senior MTS, Carnegie Mellon University, 4500 Fifth Avenue, Room 4120, Pittsburgh, PA, 15213, United States of America, smoitra@sei.cmu.edu

To assess the utility of network security technologies, criteria are needed to judge how useful they are for security. We present metrics that are important for security management. A security technology should be judged in terms of how well these metrics can be derived from their outputs. These metrics quantify cyber attack scenarios based on data security technologies should provide. Functional needs for security technologies are related to how they can provide data to estimate these metrics.

3 - Portfolio Management for Cybersecurity Technology Investments

Yueran Zhuo, University of Massachusetts Amherst, 121 Presidents Dr., Amherst, MA, 01003, United States of America, yzhuo@som.umass.edu, Senay Solak

Cybersecurity has become an integral component of a firm's business success, and thus investing on cybersecurity countermeasures is an important decision problem for many businesses. We use a portfolio approach to study the optimal cybersecurity investment decisions of a firm, where the uncertainty of cyber environment is captured through a stochastic programming framework. Results cast managerial insights for cybersecurity investment planning by a firm.

4 - How the Inventors with Independent Inventing Experiences Influence the Other Inventors' Performance

Dehong Li, Xi'an Jiaotong University, P.O.Box 2268, No.28, Xianning West Road, Xi'an, 710049, China, muzi7011@gmail.com, Wentian Cui, Jun Lin

Inventors with independent inventing experiences usually embrace tacit and essential knowledge of innovation. Using Chinese patent data, we show that cooperators can benefit from collaborating with the inventors with independent inventing experiences and this benefit decreases significantly as the distance between them increases. Moreover, the degree of benefit is moderated by the structural non-redundancy of the cooperator and the difference in status between them.

WC34

Level 2 - Room 211D

Topics in Simulation Modeling and Analysis

Sponsor: Simulation Society

Sponsored Session

Chair: Susan Hunter, Cornell University, 282 Rhodes Hall, Ithaca, United States of America, srh227@cornell.edu

1 - Some Recent Developments of Stochastic Kriging Methodology

Xi Chen, Assistant Professor, Virginia Commonwealth University, Statistical Sciences & Operations Resear, 1015 Floyd Avenue, Grace E. Harris Hall, Richmond, VA, 23284-3083, United States of America, xchen4@vcu.edu, Kai Wang, Kyoung-kuk Kim, Feng Yang

Stochastic kriging (SK) has been studied as a useful metamodeling tool for approximating the mean response surface implied by a stochastic simulation. We propose to extend the standard stochastic kriging in two directions, respectively, to enable SK to handle stochastic simulations involving both qualitative and quantitative decision variables and to upgrade SK with methods such as sectioning for better performance in predicting extreme quantiles and tail conditional expectations.

2 - Dynamic Parameter Selection for Simulation Experiments

Dashi Singham, Naval Postgraduate School, 1411 Cunningham Road, Monterey, United States of America, dsingham@nps.edu

We propose a method for dynamically changing simulation experimental settings while the model is running to determine run length. One method is to pre-determine the input parameters as functions of the simulation output, the other is to continually adjust input choices based on the observed output in a feedback control loop. We explore these ideas in the context of stopping rules for confidence interval procedures.

3 - Ranking and Selection in a High-performance Computing Environment

Eric Ni, Cornell University, 206 Rhodes Hall, Ithaca, NY, United States of America, eric.ni.cao@gmail.com, Shane Henderson, Susan Hunter

We explore ranking and selection methods implemented in a parallel computing setting. Our focus is on screening-based methods in a high-performance computing environment.

■ WC35

Level 2 - Room 212A

Robust Optimization I

Contributed Session

Chair: Angelos Georghiou, Post-doctoral research associate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, 66-363, Cambridge, MA, 02139, United States of America, angelosg@mit.edu

1 - Robust Inventory Management via the Central Limit Theorem

Shima Nassiri, University of Washington, 2735 NE 55th Street, Seattle, WA, 98105, United States of America, shiman@uw.edu, Michael Wagner, Hamed Mamani

We consider an inventory management problem in which demand is random with unknown distribution but known first and second moments. We utilize a robust approach, motivated by the Central Limit Theorem, to determine the optimal order quantities. While we minimize the worst-case cost, we also show that the realized cost of our robust approach is not much worse than that of an optimal stochastic approach, where the distribution is known.

2 - A Tractable Approximation of Robust Optimization

Amir Ardestanijaafari, PhD Student, HEC Montreal, 3000 Cote-Sainte-Catherine Road Montréal, Montreal, QC, H3S 2G4, Canada, amir.ardestani-jaafari@hec.ca, Erick Delage

Several researches have studied the stochastic inventory problem assuming partial information about the demand distribution since the work of Scarf (1958). In this research, we describe uncertainty by means of robust optimization instead of assuming partial information about the demand distribution. A tractable approximation has been proposed and applied for multi-item newsvendor problem and multi-period inventory problem. Its performance has been confirmed theoretically and numerically.

3 - The Robust Capacity Allocation Policies of the Third Party Warehouse with Uncertain Demand

Weihong Dong, Phd Candidate, Huazhong University of Science and Technology, No. 1037,Luoyu Road, Hongshan District, Wuhan, HB, 430074, China, dongweihong@hust.edu.cn, Xianhao Xu

We studied the capacity allocation policies of a third party warehouse center ,which supplied several different level services on different prices with fixed capacity, on revenue management perspective. As the demand was uncertain, we used three robust methods- absolute robust, deviation robust, relative robust- to maximize the whole revenue. Then we used some numerical examples to verify the practical applicability.

■ WC36

Level 2 - Room 212B

Health Care IX: Economic Efficiency

Contributed Session

Chair: Sriram Venkataraman, Asst Professor, Univ of South Carolina, Moore School of Business, 1705 College St., Columbia, SC, 29208, United States of America, svenkat@clemson.edu

1 - Measuring Cost Efficiency of Hospitals in the United States between 1996 and 2011

Jeong Hoon Choi, Assistant Professor, The University of Akron, 259 South Broadway, Akron, OH, 44325, United States of America, jhchoi@uakron.edu

This research formulates the frontier approach to measure the cost efficiencies of hospitals in the U.S. This study applies both Stochastic Cost Frontier Approach (SCFA) and Data Envelopment Analysis (DEA) for measuring the cost efficiency of hospitals, and analyzes the results by tracking the trend of cost efficiency and by grouping hospitals by a number of criteria such as control type, region, and size.

2 - Pricing Medical Practice Services to Minimize Revenue Risk under Bundled Payment Models

Jeremy Eckhause, LMI, 2000 Corporate Ridge, McLean, VA, 22102, United States of America, jeckhause@lmi.org, Danny Hughes

In an effort to reduce costs, emerging payment models require medical providers to assume risk by furnishing lump sum payments for all inpatient services associated with distinct episodes of care, each with its own cost profile. Under such a system, providers negotiate payments to achieve savings targets separately for each service. Employing a simulation-based optimization model, we propose a portfolio approach that achieves the required aggregate savings while minimizing risk to the provider.

3 - Simulation and Optimization for Portfolio Capacity Management in Pharmaceutical R&D

Sam Mathew, Director, Janssen Pharmaceuticals, a division of Johnson & Johnson, 522 Constitution Way, Ambler, PA, 19002, United States of America, smathe3@its.jnj.com

For Portfolio Capacity Management, we have successfully designed and deployed a simulation and optimization capability to support scenario and what-if analysis. Here we are able to design solution proposals, with 1) supply/budget allocation, and 2) portfolio composition and shifts. Here we bring together schedules, resources, costs, risk and value. These simulation and optimization techniques are often used in Portfolio Management, but rarely successfully installed in Capacity Management.

4 - Hospital and Patient Incentives to Reduce Readmission Rates: A Quality Management Framework

Sriram Venkataraman, Asst Professor, Univ of South Carolina, Moore School of Business, 1705 College St., Columbia, SC, 29208, United States of America, svenkat@clemson.edu, Shouqiang Wang, Aleda Roth, Lawrence Fredendall

This paper develops an analytic model to evaluate the potential impact of a plan of U.S. government to penalize hospitals with high readmission rates on the hospitals (providers), and the government as well as the patients. Furthermore, we look into the design of penalization scheme(s) that can better save the government expense and improve the welfare of the patients.

■ WC37

Level 2 - Room 213A

Integrated Production Scheduling

Contributed Session

Chair: Li GenQiang, Xi'an JiaoTong University, Xi'an, Shaanxi Province, Xi'an, China, ligen5168@163.com

1 - Integrated Production Scheduling and Logistics Decision Making

Farshid Azadian, Assistant Professor, Embry Riddle Aeronautical University, 600 S Clyde Morris Blvd, COB, Room 222, Daytona Beach, FL, 32114, United States of America, azadianf@erau.edu, Alper Murat, Ratna Babu Chinnam

This research studies the model and its solution approach for a production facility with multiple unrelated parallel lines. Production scheduling is linked with logistics decision making. A mathematical model is presented and an innovative solution algorithm is proposed for solving this problem. The performance of the solution algorithm is tested through case studies.

2 - Parallel Machine Scheduling Problem with Unequal Ready Times, Due Dates, Deadlines and Setup Times

Gulsah Hancerliogullari, Old Dominion University, 5115 Hampton Blvd. Kaufman Hall, Room 249, Norfolk, VA, 23529, United States of America, ghancerl@odu.edu, Emrah Koksalmis

The problem addressed is the non-preemptive parallel machine scheduling problem with unequal ready times, due dates, deadlines and sequence-dependent setup time with the objective of minimizing total weighted tardiness. We present heuristics and meta-heuristics for this problem since the problem is NP-hard and computationally evaluate the performance of the heuristics relative to lower bounds and solutions obtained using mixed-integer 0-1 programming model.

3 - Integration Scheduling of Parallel Cracking Production Process

Lijie Su, PhD, Northeastern University, Heping, Shenyang, 110819, China, sulijie@ise.neu.edu.cn, Lixin Tang

This paper considers the integration scheduling for parallel cracking production process that arise in some ethylene production plants where the feed stocks are insufficient. The objective is minimization the overall production, changeover and decoking cost through assigning, batching and sequencing feed stock flows among units. We present one MINLP formulation, and derive an efficient improved OA algorithm for solving it. Numerical experiments demonstrate the efficiency of the model and method.

4 - Machine Scheduling with Job Delivery Coordination – Focus on Time Constraints

Li GenQiang, Xi'an JiaoTong University, Xi'an, Shaanxi Province, Xi'an, China, ligen5168@163.com, Li Jie, Liu Zihan

This paper considers a scheduling, batching and delivery problem. A single vehicle transport jobs with outlaying time constraints from one manufacturer to multi-customers. We schedule the producing sequence and routing to minimize the total cost, including holding, transporting and outdated cost. A mathematical model is formulated and a GA-based heuristic approach is proposed to solve this problem. An instance of injection proved that it can improve the efficiency of supply chains.

■ WC38

Level 2 - Room 213B

Supply Chain Management I

Contributed Session

Chair: Hui Dong, Rutgers Business School, 1 Washington Park 902B, Newark, NJ, 07102, United States of America, huidong@rutgers.edu

1 - Supply Management and Discount Analysis of Independent Pharmacy

Kwon Gi Mun, PhD Candidate, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, kwongmun@pegasus.rutgers.edu, Yao Zhao

Independent drugstores have the lowest avg. revenue, and competition is increasingly intensive in the past 20 years so that a declining trend in the number of independent drugstores has been shown. Therefore these drugstores have considered new purchasing strategies. This paper shows that heuristics explain how to save cost with new ordering policy. This research also suggests a math model. Thus we construct systematical heuristic procurement strategies that suggest new economic ordering scheme.

2 - A System Dynamics Model for Developing Scenarios

Shardul Phadnis, Postdoctoral Associate, Massachusetts Institute of Technology, 77 Massachusetts Ave., E40-207, Cambridge, MA, 02139, United States of America, shardul@mit.edu

Scenario planning is often used for long-range planning (e.g. transportation infrastructure planning, formulating business strategies), when the future environment cannot be predicted with adequate accuracy. However, one of most common scenario planning methodsóIntuitive Logics Schoolótakes a rather ad-hoc approach to developing scenarios, which are used for making such important decisions. In this paper, we show that system dynamics modeling can be a systematic method for scenario development.

3 - The Impact of Unethical Behavior on Supplier Selection

Swathi Reddy Baddam, Doctoral Student, Cleveland State University, 2121 Euclid Avenue, BU 539, Cleveland, OH, 44115, United States of America, swathi.baddam@gmail.com, Jen-Yi (Jay) Chen

Motivated by recent events of fire accidents and unsafe working conditions at supplier factories, this research considers the risk of unethical behavior from a sustainability perspective in selecting suppliers. It discusses the trade-off among sourcing costs, impact of unethical events, and supplier relationship.

4 - Operations of a Time-sensitive Assembling Network with Uncertain Component Supplies

Hui Dong, Rutgers Business School, 1 Washington Park 902B, Newark, NJ, 07102, United States of America, huidong@rutgers.edu

We study a general assembling network with multiple contracted manufacturers who assemble components into final product and multiple customers with heterogeneous demands. Lead time is non-negligible over the network and one of the component suppliers has uncertain delay for delivering. The objective is to optimize the stochastic expectation of weighted delivery time for the final product. An algorithm is proposed and different distributions for the delay are analyzed.

■ WC41

Level 1 -101A

Data-driven Approaches in Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Omar Besbes, Columbia University, Graduate School of Business, 3022 Broadway, New York, NY, 10027, United States of America, ob2105@columbia.edu

1 - A Two-stage Model of Consideration Set and Choice

Srikanth Jagabathula, Professor, NYU Stern School of Business, 44 West Fourth Street, KMC Suite 8-74, new york, NY, 10012, United States of America, sjagabat@stern.nyu.edu, Paat Rusmevichientong

A main challenge in demand modeling is to strike a balance between flexibility (ability to extrapolate) and performance (prediction accuracy) while keeping the model computationally tractable.We strike this balance through a new two-stage demand model: customers first pick a consideration set (a smaller subset of "relevant" products) and then choose the most preferred product from the consideration set. We propose techniques to estimate these models from purchase transaction data.

2 - Uncertainty and Risk Estimation from Large Data

Mohsen Bayati, Assistant Professor, Stanford University, Graduate School of Business, Stanford, United States of America, bayati@stanford.edu, Murat Erdogdu, Andrea Montanari

We study the fundamental problems of variance and risk estimation in high dimensional statistical modeling that has recently experienced a resurgence due to new applications, such as data-driven healthcare and online advertising. In this context, we develop new estimators for the estimation risk and the variance of the noise from the data.

3 - Real-time Optimization of Personalized Assortments

Hamid Nazerzadeh, Assistant Professor, Marshall School of Business, University of Southern California, Los Angeles, CA, United States of America, hamidnz@marshall.usc.edu, Negin Golrezaei, Paat Rusmevichientong

We consider the problem of personalizing the assortment of products to each arriving customer. Through actual sales data from an online retailer, we demonstrate that personalization based on each customer's location can lead to over 10% improvements in revenue, compared to a policy that treats all customers the same. We propose a family of index-based policies with performance guarantee that effectively coordinate the real-time assortment decisions with the backend supply chain constraints.

4 - Dynamic Content Recommendations: Optimizing Path-wise Performance

Yonatan Gur, Columbia University, 3022 Broadway, New York, NY, 10027, United States of America, ygur14@gsb.columbia.edu, Assaf Zeevi, Omar Besbes

A new class of online services allows publishers to direct readers to other web-based content they may be interested in. We study this dynamic recommendation problem and its rapidly changing, "big-data" environment. We develop a representation of content along two key dimensions, based on which we propose a class of user-path focused heuristics. Work is based on collaboration with a leading provider of online content recommendations.

■ WC42

Level 1 -101B

Pricing and Revenue Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Amr Farahat, Washington University-St. Louis, 1 Brookings Drive, Campus Box 1133, St. Louis, MO, 63130, United States of America, farahat@wustl.edu

1 - Assortment Optimization under the Multinomial Logit Model with Totally Unimodular Constraints

James Davis, Cornell University, Rhodes hall, Ithaca, United States of America, jamesmariodavis@gmail.com, Guillermo Gallego, Huseyin Topaloglu

We consider assortment optimization problems under the multinomial logit model with a totally unimodular constraint on the assortment of offered products. We show that this problem can be solved as a linear program. Building on this result, we show how to solve various classes of assortment and pricing models, including assortment problems with display location-specific preference weights and pricing problems with price-laddering constraints.

2 - Retailing with Opaque Products

Adam Elmachtoub, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, ane@mit.edu, Yehua Wei

An opaque product is where the consumer only learns of the entire product's characteristics after the purchase is complete. Opaque products have been used in the travel industry, where consumers can buy airline tickets without knowing which airline or flight they will receive. Unlike airlines, we propose that online retailers sell opaque products directly alongside traditional products. Our results show that retailing with opaque products is beneficial from both revenue and cost perspectives.

3 - Dynamic Pricing of Fashion Goods under Strategic Consumer Behavior

Mike Wei, Washington University in St. Louis, 1 Brookings Dr., Campus Box 1133, St. Louis, MO, 63130, United States of America, weim@wustl.edu, Yossi Aviv, Fuqiang Zhang

We study pricing models of fashion goods under strategic consumer behavior. Using a rigorously developed game theoretical framework, we demonstrate that acquiring the ability to resolve demand uncertainty via early sales observations may potentially be detrimental to revenue performance. We discuss the underlying reasons behind this phenomenon, the conditions under which it prevails, and its practical ramifications. We also discuss the efficacy of a "reward program" as a segmentation mechanism.

4 - The Multi-product Newsvendor Problem with Customer Choice

Amr Farahat, Washington University-St. Louis, 1 Brookings Drive, Campus Box 1133, St. Louis, MO, 63130, United States of America, farahat@wustl.edu, Joonkyum Lee

We study the stocking problem facing a newsvendor offering multiple products where customer choice depends on the set of available products at the time of purchase. We present a tractable approach, guaranteed to yield upper bounds on the optimal value, and numerical results that outperform current benchmarks.

■ WC43

Level 1 -101C

Stochastic Optimization II

Contributed Session

Chair: Jeremy Castaing, PhD Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, jctg@umich.edu

1 - Ambiguous Probabilistic Programs

Zhaolin Hu, Assistant Professor, Tongji University, School of Economics and Management, No.1239, Siping Road, Yangpu District, Shanghai, 200092, China, huzhaolin@gmail.com, Jeff Hong

We study ambiguous probabilistic programs where the ambiguity is defined by the likelihood ratio of the distribution. Of special interest are the band ambiguity set and the sets defined by various phi divergence measures. Using change of measure and duality theory, we show the ambiguous probability minimization problem (PM) can be reduced to a pure PM and the ambiguous chance constrained program (CCP) can be reformulated as a CCP with the confidence level being rescaled from the original one.

2 - Sequentially Choosing Some among Several Competitors

Kemal Gursoy, Instructor, Rutgers University, Hill Center, Room 469, 110 Frelinghuysen Road, Piscataway, NJ, 08854, United States of America, kgursoy@rci.rutgers.edu

It is desirable to find sequential policies for resource utilization in order to achieve an optimal return. In this work we have considered many influential stochastic competitors, such that when some of them are taken together, they collectively provide a revenue and this selection influences the behavior of other competitors. Here, competitors have been modeled as generalized multi-armed bandit processes with discounted rewards.

3 - Analysis of a Spare Parts Pooling System under Service Level Constraint

Benhür Satir, Assisstant Professor Doctor, Ankaya University, Eskisehir Yolu 29. Km, Ankara, 06910, Turkey, benhur@cankaya.edu.tr, Duygu Küçükyelkenci Alper

In this study, we analyze the operating policy of a dealer operating in a decentralized spare parts network which maximizes profit under a given service level. In the network, collaboration occurs among dealers via spare parts pooling. In most of the studies, loss of customer goodwill cost due to waiting under poor service is assumed, which is under question due to the problems with its quantification. We assume service level constraint instead of this cost.

4 - Optimally Scheduling Satellite Communications with Energy and Data Dynamics under Uncertainty

Jeremy Castaing, PhD Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, jctg@umich.edu, Amy Cohn, James Cutler

We consider the problem of scheduling and managing the download of data from a collecting satellite to receiving ground stations. We introduce Stochasticity in the model by assuming that each ground station is only available with a certain probability and we introduce a chance constraint equivalent to download at least a pre-determined amount of data (target) with at least a given probability.

■ WC44

Level 1 -101D

Supply Chain: Optimization III

Contributed Session

Chair: Jun Zhang, Assistant Professor, North Dakota State University, IME department, Fargo, ND, 58102, United States of America, Jun.Zhang@ndsu.edu

1 - The Management of Recycled Products in a Reverse Supply Chain

Abdelghani Elimam, Professor, American University in Cairo, Mechanical Engineering Dept, School of Sciences and Engineering, New Cairo, 11835, Egypt, aelimam@aucegypt.edu, Bajis Dodin

Sustainability stresses the need for Reverse Supply Chain (RSC) management. RSCs include a top tier for collecting used products, intermediate tiers for disassembling these items, and the bottom tier for the recovered material distribution. The paper models RSC as a Project Network that is formulated as a Mixed Integer Program to optimize the transportation, inventory, and disassembly costs and the corresponding recycle time. The approach is illustrated using auto parts, and municipal waste.

2 - A Distribution Network Design Problem: The Case of Frozen Food Industry

Amin Chaabane, Professor, Ecole de Technologie Supérieure, 1100, Rue Notre-Dame Ouest, Montreal, QC, H3C 1K3, Canada, Amin.Chaabane@etsmtl.ca

In this work, we deal with a food distribution problem that can be considered as a generalization of the multi-period production distribution network design problem. In particular, we are involved with a real application related to a Canadian company that holds food markets in North America and has to determine the distribution network structure. Our results suggest that companies using efficient forecasting policies tend to reduce the number of third party logistics and may enjoy cost reduction.

3 - An Adaptive Broken Knapsack Problem

Kai Chen, Ph.D student, University of Southern California, 1211 W 37th Dr, Apt. 6, Los Angeles, Ca, 90007, United States of America, kaic@usc.edu, Sheldon Ross

We consider a stochastic knapsack problem in which the event of over-flow leads to the loss of all items in the knapsack. We have to make a decision on each stage whether to stop, or continue to put an item of a selected type in the knapsack. An item's weight is learned when placed to the knapsack. The objective is to find a policy that maximizes the expected total values. The optimal policy is found when $n = 2$ and a heuristic policy is suggested for $n > 2$.

■ WC45

Level 1 -101E

Supply Chain Under Competition

Contributed Session

Chair: Anyan Qi, University of Michigan, 701 Tappan St. R4421, Ann Arbor, MI, 48109, United States of America, anyqi@umich.edu

1 - Cooperative Advertising Program for a Two-echelon Supply Chain under Competition

Saman Hassanzadeh Amin, Postdoctoral Fellow, Faculty of Business and IT, University of Ontario Institute of Technology, 2000 Simcoe Street North, Oshawa, ON, L1H 7K4, Canada, SamanHassanzadeh.Amin@uoit.ca, Salma Karray

In this research, we develop a game-theoretic model for a two-echelon supply chain including one manufacturer and two retailers. First, equilibriums of a Stackelberg-manufacturer game are calculated. Then, the results of cooperation are obtained and they are compared with the Stackelberg-manufacturer game. The system profit in cooperation is higher than the total profits in Stackelberg-manufacturer game.

2 - The Impact of Supply Chain Structure on the Wholesale Prices

Alper Nakkas, Assistant Professor, SKK Graduate School of Business, 25-2 Sungkyunkwan Street, Jongro-gu, Seoul, 110-745, Korea, Republic of, nakkas@skku.edu

Supply chains can be very complex and highly asymmetric structures. The impact of these structures on the surplus sharing between retailers and their manufacturers is not straightforward. We examine the bargaining between multiple retailers and multiple manufacturers over the wholesale prices and show that the equilibrium behavior of the retailers and manufacturers can be deducted from their behavior in the smaller supply chain network structures that are determined by a decomposition algorithm.

3 - When and Why is Servitization a Profitable Competitive Strategy?
Sung Hee Lee, Ph.D. Candidate, Korea University Business School, Rm No. 516, Main Hall of Business School, Anam-dong, Seongbuk-gu, Seoul, 136-701, Korea, Republic of, cool_scm@korea.ac.kr, Shijin Yoo, Hyejung Kwon, Daeki Kim

Servitization has been emerged as an alternative competitive strategy for manufacturers. By various kinds of product-service integrations, manufacturers have attempted to increase their competitive advantage in a market, and as a result, to secure higher profitability. The purpose of this study is to shed light on key success factors of servitization under different channel structures. The current work will provide a series of propositions regarding successful servitization strategies.

4 - To Share or Not to Share? Capacity Investments in a Shared Supplier
Anyan Qi, University of Michigan, 701 Tappan St. R4421, Ann Arbor, MI, 48109, United States of America, anyqi@umich.edu, Hyun-Soo Ahn, Amitabh Sinha

We study firms' capacity decisions (types and levels) when multiple firms invest in a shared supplier. We examine two capacity types: exclusive, where the leftover capacity cannot be used to fill other firms' order, and first-priority, where it can. We find that firms generally pursue exclusivity, resulting in a prisoners' dilemma, and one firm may invest in first-priority capacity, allowing the other with exclusive capacity to free-ride. We also characterize the impact of market environment.

■ WC46

Level 1 -101F

Environmental Sustainability and Behavior Adoption

Contributed Session

Chair: Ismail Capar, Texas A&M University, 3367 TAMU, College Station, TX, 77843, United States of America, capar@tamu.edu

1 - Impact of Emissions Control on Electric Vehicle Adoption and Profitability
Saravanan Kuppusamy, PhD Candidate, University of Cincinnati, 501 Carl H. Lindner Hall, 2925 Campus Green Drive, cincinnati, oh, 45221, United States of America, kuppussn@mail.uc.edu, Uday Rao, Michael Magazine

We seek to understand the impact of emissions control on EV adoption and profitability. We address the following questions: Can taxing emissions improve EV adoption? Can tighter cap on emissions lead to improved EV adoption? Is it possible to reduce the emissions without significantly reducing the profits? Which policy - emission taxes or cap - is better in improving EV adoption?

2 - Information Availability, Perceived Technological Uncertainty and Adoption of Photovoltaic Systems
Shadi Goodarzi, Student, HEC Paris, 1 Rue de la Liberation, Operation Management Departement, Jouy en Josas, 78350, France, shadi.goodarzi@hec.edu, Sam Aflaki, Andrea Masini

We examine the actual adoption behavior of the clients of a large utility company to study how economic and behavioral factors affect the adoption of photovoltaic systems. We show that, adopters and non-adopters are different in types of knowledge ,sources of PV information , and perceived technological uncertainty .

3 - Vehicle Routing Formulations to Evaluate Adoption of Electric Vehicles for a Fleet
Ismail Capar, Texas A&M University, 3367 TAMU, College Station, TX, 77843, United States of America, capar@tamu.edu, Mesut Yavuz

We present a new vehicle routing problem with various objective functions. These objective functions are utilized to show how introduction of electric vehicles (EV) would impact the overall operations of the fleet containing internal combustion engine vehicles at the beginning. In addition, numerical experiment results are presented to evaluate performance of the three proposed vehicle routing heuristics that take EV's range and charging facility availability into account.

■ WC47

Level 1 -101G

Operations Management III: Topics in OM

Contributed Session

Chair: Xiaojin Liu, University of Minnesota, 3-150 CSOM, 321-19th Avenue South, Minneapolis, MN, United States of America, liux1591@umn.edu

1 - On Solving Optimal Parameter Selection/Estimation Problems as MPECs
Yu-Ching Lee, Postdoctoral Research Associate, University of Illinois at Urbana-Champaign, 117 Transportation Bldg., 104 S. Mathews, Urbana, IL, 61801, United States of America, ylee77@illinois.edu, Jong-Shi Pang

We will show that a parameter selection problem is suitable to be formulated as a Mathematical Program with Equilibrium Constraints (MPEC), and two examples—-parameter selection for Support Vector Machine (SVM) Regression and parameter estimation for pure characteristics demand function—-are being discussed. Algorithms to solve for the global optimal solution and the numerical results are reported.

2 - The Impact of Social Issues Management on Firm Performance
Amrou Awaysheh, IE Business School, Maria de Molina, 12-5, Madrid, 28006, Spain, amrou.awaysheh@ie.edu

This paper presents a theoretical model that links effective social issues management with financial performance, and tests it by analyzing the shareholder value effects associated with the announcement of social issues. Empirical results show a negative 1.11% Cumulative Abnormal Return (CAR) associated with the announcement of negative news. The announcement of positive social performance results in a positive CAR of 1.20%. Further analysis is presented.

3 - Work Design and Work Safety in Manufacturing Industry
Xiaojin Liu, University of Minnesota, 3-150 CSOM, 321-19th Avenue South, Minneapolis, MN, United States of America, liux1591@umn.edu

Recent research recognizes the critical role of work design and working conditions in Operations Management. Yet, little is known about how they affect the operations performance and what the joint implication is for management. This study develops a theoretical framework and conducts empirical analysis to investigate our propositions. Contribution is discussed.

■ WC48

Level 1 -101H

Decision Making by Supply Chain Planners: Empirical Studies and Models

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Jan Fransoo, Professor, Eindhoven University of Technology, PO Box 513, Pav F4, Eindhoven, Netherlands, J.C.Fransoo@tue.nl

1 - The Effect of Human Behavior in Supply Chain Performance: A Control Theoretic Study
Maximiliano Udenio, PhD Student, Eindhoven University of Technology, PO Box 513, PAV F14, Eindhoven, 5600MB, Netherlands, m.udenio@tue.nl, Jan Fransoo, Eleni Vatamidou, Nico Dellaert

We use linear control theory to analyze the performance of a firm generating material orders as a function of the difference between actual inventory and pipeline and their respective targets. We explicitly model managerial behavior by allowing fractional –instead of full– adjustments to be performed in each period, thus introducing a proxy to the firms' reactiveness to changes. We illustrate the practical importance of this research by including links to empirical and experimental data.

2 - Modifying Replenishment Order Recommendations: Drivers, Characteristics, and Impacts
Bo Li, Doctoral Student, Texas A&M University, 320M Wehner Bldg, College Station, TX, 77843, United States of America, bli@mays.tamu.edu, Rogelio Oliva

Store managers may modify order recommendations generated by the automatic replenishment system and achieve, on average, considerable savings. However, only about half of these modifications manage to reduce cost of inventory-holding and lost-sales. With data from a European retailer, we examine the drivers, characteristics and impacts of manager behavior in order modification, and propose decision rules that regulate manager behavior and enhance managers' effectiveness.

3 - Scheduling the Scheduling Task: A Time Management Perspective on Scheduling
Jan Fransoo, Professor, Eindhoven University of Technology, PO Box 513, Pav F4, Eindhoven, Netherlands, J.C.Fransoo@tue.nl, Jose Antonio Larco Martinelli, Vincent Wiers

Using a field study we develop a framework to describe the scheduler job's from a time perspective, separating endogenous and exogenous factors. The framework provides information on how the scheduler may take decisions to be more responsive and time efficient.

4 - The Schedulers Balancing Act of Sensing and Reacting
Jose Antonio Larco Martinelli, CENTRUM Catòlica Business School, Jr. Daniel Alomìa Robles 125 Surco, Lima, Peru, jlarco@pucp.pe, Jan Fransoo, Vincent Wiers

Schedulers are required to be responsive to changes in the "world" they manage. To be responsive, they need to both, sense changes and react to these. We use a simulation study to assess how schedulers balance sensing and reacting activities in the field, finding significant opportunities for enhancing responsiveness.

■ WC49

Level 1 -101I

Portfolio Optimisation: Models and Solution Approaches

Cluster: Tutorials
Invited Session

Chair: John Beasley, Brunel University, Mathematical Sciences, & JB Consultants, United Kingdom, John.Beasley@brunel.ac.uk; john.beasley@jbconsultants.biz

1 - Portfolio Optimisation: Models and Solution Approaches
John Beasley, Brunel University, Mathematical Sciences, & JB Consultants, United Kingdom, John.Beasley@brunel.ac.uk; john.beasley@jbconsultants.biz

We review financial portfolio optimisation. Markowitz mean-variance portfolio optimisation is relatively well known, but has been extended in recent years to encompass cardinality constraints. Less considered in the scientific literature are portfolio optimisation problems such as: index tracking; enhanced indexation; absolute return; market neutral. We outline the mathematical optimisation models that can be adopted for portfolio problems such as these and solution approaches that can be used.

■ WC50

Level 1 -101J

Marketing Strategies and Financial Performance

Contributed Session

Chair: Chaocheng Gu, PhD Student, Huazhong University of Science and Technology, School of Management, Luoyu Road 1037, Wuhan, HB, 430074, China, ccgu.hust@gmail.com

1 - The Impact of Product Recalls on Firms' Financial Performance in Chinese Market
Xia Pan, associate professor, Sun Yat-sen University, 135 Xin Gang Xi Road, Guangzhou, 510275, China, panxpappers@gmail.com

Product recall has been considered as an emergent management measure to deal with the quality problems in firms sold products. People may view product as a negative sign for the firm in short run but positive sign in long run. We study the impact of the product recalls in Chinese market of the corresponding firms' financial performance, mainly on stock market. The event study method is used in the study.

2 - Cross-Market Pairs Trading Strategy Construction
Ying Huang, PhD Candidate, City University of Hong Kong, 302D, Hall 8, Student Residence, Hong Kong, Hong Kong - PRC, carolhying@gmail.com

In this paper, we study the general pairs trading strategies in commodity market and attempt to propose a theoretical stochastic approach to construct pair trading strategies in cross markets. We also investigate the performance of our model with Monte Carlo simulation comparing with out-of-sample tests in currency market and commodity market.

3 - Marketing Intensity, Financial Leverage, and Firm Valuation
Sang-Joon Kim, University of California, Irvine, The Paul Merage School of Business, Irvine, 92697, United States of America, sangjok@uci.edu, Hannah Oh, John Bae

This study attempts to reconcile two strands of research on impacts of financial leverage on firm valuation, and argues that the bifurcated signaling effects can be positively moderated by the intensity of marketing activities. Using COMPUSTAT database of 1481 U.S. public firms ranging from 1970 to 2011, we found the U-shaped relationship between financial leverage and Tobin's q and the positive interaction effect of marketing intensity on the curvilinear relationship.

4 - Optimal Invoice Factoring Strategy for Cash-constrained Manufacturers
Chaocheng Gu, PhD Student, Huazhong University of Science and Technology, School of Management, Luoyu Road 1037, Wuhan, HB, 430074, China, ccgu.hust@gmail.com, Shiming Deng

We investigate two factoring strategies respectively called 'fixed maturity strategy' and 'Just in time strategy'. We examine the two-side effects of factoring and find an optimal timing in the fixed maturity strategy. A comparison of the two strategies indicates that the Just in Time Strategy may perform worse than the Fixed Maturity Strategy. Our numerical study shows that the factor can actually improve his profit by charging lower fee rates.

■ WC51

Level 1 -102D

Modeling for Innovative Vehicle Technologies

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)
Sponsored Session

Chair: Jonathan Adler, Arizona State University, 699 S Mill Ave., Tempe, AZ, 85281, United States of America, jonadler@asu.edu

1 - Scheduling and Long-term Pricing of Electric Vehicle Charging in Parking Lots with Shared Resources
Ajay Deshpande, IBM, Yorktown Heights, NY, United States of America, ajayd@us.ibm.com, Pavankumar Murali

With the growth in the use of electric vehicles (EVs), management of shared charging infrastructure under varying customer demands, schedules and time-varying electricity prices presents a novel servicing opportunity. We formulate the combined pricing-scheduling problem as a quadratic integer program and propose a tractable algorithm to find long-term charging permit prices for different arrival-departure-demand bundles and the corresponding charging schedules.

2 - Multi-period Planning for Electric-car Charging Station Locations: A Case of Korean Expressways
Sung Chung, New Mexico Tech, 801 Leroy Place, Socorro, 87801, United States of America, schung@nmt.edu, Changhyun Kwon

We present a multi-period planning problem that extends a flow-refueling location model. We develop a case study based on the real traffic flow data of the Korean Expressway network in 2011, for which it is highly desirable to build charging stations within the network. We discuss performances of single-period and multi-period models.

3 - Online Routing of Electric Vehicles in a Network with Battery Swapping
Jonathan Adler, Arizona State University, 699 S Mill Ave., Tempe, AZ, 85281, United States of America, jonadler@asu.edu, Pitu Mirchandani

Electric vehicles with swappable batteries are increasing in popularity, however their future success relies on the availability of charged batteries at located stations. In this talk we present a mathematical model minimizing the average distance traveled by electric vehicles in a network with limited swapping stations. The routes chosen for the vehicles are dependent on the current inventory status of the stations taking into account unknown future arrivals.

4 - Planning Plug-in Electrical Vehicles Recharging Infrastructure in CBD area
Yu Nie, Associate Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60608, United States of America, y-nie@northwestern.edu, Mehrnaz Ghamami, Ali Zockaie Kheiraie

This study considers recharging stations in the CBD area. Based on the basic model (available in literature), which considers building and transport costs, a deterministic capacitated model is proposed which considers the inconvenience of unmet demand and switching parking lots, followed by a stochastic model under demand uncertainty. The compatibility of these models with real world situations makes them a great tool for policy makers and charging station companies as this industry grows.

■ WC52

Level 1 -102E

New Applications in Stochastic Routing

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Stacy Voccia, PhD Candidate, University of Iowa, S210 John Pappajohn Bus. Bldg., Iowa City, IA, 52242, United States of America, stacy-voccia@uiowa.edu

1 - Planning Strategies for Home Health Care Delivery

Maciek Nowak, Associate Professor, Loyola University Chicago, 1 E. Pearson, Chicago, IL, 60611, United States of America, mnowak4@luc.edu, Mike Hewitt, Nisha Nataraj

In home health care, where a patient receives care for two to three months, continuity of care is very important. Previous research focusing on continuity of care uses planning horizons that are often a week or shorter. We demonstrate that considering a longer horizon in this setting has potential for savings. With inherent uncertainty in planning for such a long time horizon, a methodology is presented that anticipates future patient requests that are unknown at the time of planning.

2 - Modeling the Impact of Correlation on the Telemetry Location Problem

Amit Verma, University of Iowa, Ames, IA, United States of America, amit-verma@uiowa.edu, Ann Campbell

Telemetry units can be used to gauge inventory levels at customers which can help prevent stockouts and unnecessary deliveries. If telemetry units are placed at some customers, knowledge of customer usage correlation can be used to provide better usage information for other customers. We present a model for the problem of where to place a limited number of telemetry units to minimize routing costs that involves customer usage correlation. We will present a heuristic and computational results.

3 - Period Vehicle Routing with Stochastic Service Requests

Luis de la Torre, PhD Candidate, Northwestern University, 2145 Sheridan Road, C210, Evanston, IL, 60208, United States of America, ledelatorre@u.northwestern.edu, Irina Dolinskaya, Karen Smilowitz

We introduce and study models and operational policies for a probabilistic period vehicle routing problem with two customer types. Regular customers require repeated service over a time horizon, while special customers have a probability of requesting service during the horizon. We present a two-stage model to minimize expected routing costs while maintaining customer consistency; routes are created before demand realizations and special customers are re-optimized after demand realizations.

4 - Same Day Delivery for Online Purchases

Stacy Voccia, PhD Candidate, University of Iowa, S210 John Pappajohn Bus. Bldg., Iowa City, IA, 52242, United States of America, stacy-voccia@uiowa.edu, Ann Campbell, Barrett Thomas

Same day delivery for online purchases is a trend being embraced by Amazon, Wal-Mart, eBay, Google, and a handful of recent Internet startups. Same day delivery, however, is a logistically complicated and expensive service to operate. There is a need for efficient routing strategies for large-scale operations. We introduce a dynamic pick-up and delivery problem with deadlines that incorporates key features associated with same day delivery logistics.

■ WC53

Level 1 -102F

Maritime Transportation

Contributed Session

Chair: Furkan Oztanriseven, PhD Student, University of Arkansas, 1900 N. Garland Avenue, Apt. #26, Fayetteville, AR, 72703, United States of America, foztanri@uark.edu

1 - Strategies to Deal with Uncertainty in Real Time in the Berth Allocation Problem

Nitish Umang, EPFL, Route Cantonale 15, Lausanne, Switzerland, nitish.umang@epfl.ch

We solve the berth allocation problem in real time accounting for the stochastic variability in the arrival and handling times of the vessels. The proposed methodology for schedule recovery is based on the re-optimization of the unassigned vessels in the berthing schedule in the events of disruption using a set-partitioning method, and an alternative smart greedy approach. Results indicate that the proposed algorithms can significantly reduce the cost of reassigning vessels at the port.

2 - On the Fuel Consumption Function for a Vessel under Changing Sailing Conditions

Chen Li, IELM Department, HKUST, HKUST, Hong Kong, Hong Kong, Hong Kong - PRC, cliad@ust.hk, Xiangtong QI, Jianbin LI

In maritime network planning, it is usually assumed that each leg between two ports has a given fuel consumption function, and a speed can be derived for each leg. We argue that this speed should be an average speed of the leg when the vessel can save fuel by adjusting its speed several times within the leg. This paper aims to investigate the properties of the fuel consumption resulted by adjusting speed as a function of the average speed, with respect to monotonicity and convexity.

3 - A Mathematical Model of Maritime Transport for Energy Resource with Choke Points Risk

Shigeki Toriumi, Dr., Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, 112-8551, Japan, toriumi@ise.chuo-u.ac.jp, Ryuta Takashima

For many countries, energy and natural resources are imported by the maritime transport. It is, therefore, necessary to consider safety of the sea lanes for energy security. One of policies to ensure the safety of the sea lanes includes decrease in the dependence on the choke points for the maritime transport. In this work, we analyze the relationship between the transport cost and the dependence on the choke points by means of the sea lane network and the LMIU's vessel movement database.

4 - An Economic Impact Study of the Arkansas Navigable Inland Waterways

Furkan Oztanriseven, PhD Student, University of Arkansas, 1900 N. Garland Avenue, Apt. #26, Fayetteville, AR, 72703, United States of America, foztanri@uark.edu, Heather Nachtmann

The navigable inland waterway transportation system is vital for the United States' economy. We use publicly available data to assess the economic impact of the Arkansas navigable inland waterway system. Four economic indicators, namely gross domestic product by state, gross output, employee earnings, and employment are selected for our analysis. Additionally, we use Monte Carlo simulation and sensitivity analysis to investigate additional cost incurred for different disruption scenarios.

■ WC54

Level 1 -103A

Traffic Signal Control and Performance Measurement

Sponsor: Transportation Science & Logistics/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Henry X. Liu, Associate Professor, University of Minnesota, Minneapolis, MN, 55455, United States of America, henryliu@umn.edu

1 - Stochastic Shortest Path Problem with Coordinated Traffic Signals

Henry X. Liu, Associate Professor, University of Minnesota, Minneapolis, MN, 55455, United States of America, henryliu@umn.edu, Jie Sun

Shortest path problem (SPP) is important to many applications in ITS and has been studied extensively in the literature. However, little attention has been paid to the SPPs within a signalized traffic network, especially with coordinated traffic signals. In this talk, we will discuss a shortest path search algorithm that will consider traffic signal coordination parameters. The model is tested using the real-world data collected from the City of Pasadena in California.

2 - A Data-driven Performance Fine-tuning Tool for Arterial Traffic Signal Systems

Henry X. Liu, Associate Professor, University of Minnesota, Minneapolis, MN, 55455, United States of America, henryliu@umn.edu, Jianfeng Zheng

In the current state-of-the-practice, traffic signals are being re-timed manually for every 3-5 years or longer because the retiming process is labor intensive. In this talk, we will introduce a performance fine-tuning tool that aims to reduce the retiming cost by leveraging the massive high-resolution event-based traffic signal data.

3 - Cooperative Infrastructure and Vehicle Intersection Control: Evaluation and Design using an Integrated Traffic-Driving-Networking Simulator

Yunjie Zhao, Student, University at Buffalo, SUNY, 204c Ketter Hall, Amherst, NY, 14226, United States of America, yunjiezh@buffalo.edu, Yunfei Hou, Aditya Wagh, Kevin Hulme, Adel Sadek, Chunming Qiao

This paper describes a trans-disciplinary research initiative aimed at developing an integrated traffic-driving-networking simulator for the design and evaluation of Cyber Transportation Systems and Connected Vehicle applications. The study demonstrates the unique advantages of human-in-the-loop in the evaluation and design of CTS applications. A truly Cooperative Infrastructure and Vehicle Intersection Control is deployed to optimize both the signal timing and approach vehicle speed profile.

■ WC55

Level 1 -103B

Scheduling in Semiconductor Industry

Contributed Session

Chair: Sreenath Chalil Madathil, Clemson University, Department of Industrial Engineering, 110 Freeman Hall, Clemson, SC, 29634, United States of America, schalil@clemson.edu

1 - Real-time Scheduling on Cluster Tools in a Semiconductor Wafer Manufacturing Facility

Sang-Oh Shim, Hanbat National University, Deokmyong-Dong Yuseong-Gu, Daejeon, Korea, Republic of, mizar0110@gmail.com

A dispatching rule based real-time scheduling method is suggested for cluster tools that produce multiple product types in semiconductor wafer fabs. In this research, several production types of cluster tools are categorized according to the flow processings of wafers and new production scheduling methods based on the dispatching rules are developed.

2 - Multi-pass Lots Scheduling for Assembly and Test Operations in Semiconductor Manufacturing

Zhufeng Gao, The University of Texas at Austin, 2004 E. Dean Keeton, Street C2200, Austin, TX, 78712-1591, United States of America, gaozhufeng@gmail.com, Jonathan Bard

We investigate the daily scheduling of lots in a re-entrant flow environment where a lot may go through the system several times. Work in process lots that have more than a single step remaining in their route are referred to as multi-pass lots. The scheduling problem is to determine machine setups, lot assignments and lot sequences to achieve optimal output. We design a multi-stage approach considering first-pass, additional passes and changeovers to obtain a solution in reasonable time.

3 - An Optimal Scheduling in Semiconductor Wet Bench Process

Wenyih Lee, Chang Gung University, 259 Wenhua 1st Road, Kweishan, Taoyuan, Taiwan - ROC, leewe@mail.cgu.edu.tw

The aim of this study is to develop an optimal wet bench scheduling at a semiconductor firm. A mathematical programming model was constructed and the optimal solution was obtained by running the IBM iLOG CPLEX. The results show that the proposed method effectively increases the utilization rate of chemical tank, the wafer output per hour, and also improves the balance of the production line.

4 - Models for Improved Photolithography Scheduling with Cluster Tools

Sreenath Chalil Madathil, Clemson University, Department of Industrial Engineering, 110 Freeman Hall, Clemson, SC, 29634, United States of America, schalil@clemson.edu, Scott Mason

Photolithography is typically the bottleneck process in semiconductor manufacturing. We present a model for optimizing photolithography job scheduling in the presence of both individual and cluster tools. We seek separately to minimize total weighted completion time and maximize on-time delivery performance. Based on our industrial case study, our mathematical- and heuristic-based approaches show promise for real world implementation in the semiconductor industry.

■ WC56

Level 1 -103C

Smart Grid Optimization

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Seyedamirabbas Mousavian, PhD Candidate, Auburn University, 257 South Gay Street Apt. 201B, Auburn, AL, 36830, United States of America, szm0032@auburn.edu

1 - Decentralized Control of Plug-in Electric Vehicle Charging via Multi-agent Coordination in Microgrid

Jianhui Wang, Affiliate Professor, Auburn University, 9700 S. Cass Avenue, Bldg. 221, Argonne, IL 60439, USA, Argonne, IL, 60439, United States of America, jianhui.wang@anl.gov, Chen Chen

In this work we propose a decentralized control scheme, which utilizes the new development of distributed optimization algorithms in operation research, for plug-in electric vehicle charging in microgrids.

2 - Chance Constrained Optimal Power Flow for Topology Uncertainty

Russell Bent, Los Alamos National Laboratory, Lanl, Mail Stop C933, PO Box 1663, Los Alamos, NM, 87545, United States of America, rbent@lanl.gov, Eli Chertkov, Daniel Bienstock, Earl Lawrence, Scott vander Wiel

Optimal power flow (OPF) is used to aid operators of electric power systems to identify the least cost generation to satisfy demand for electric power. OPF relies on deterministic information about the state of a power grid. However, much of this information is derived from state estimation that may provide erroneous data. We use recent advances in quantifying the uncertainty associated with topology state estimation and include that uncertainty into OPF formulations as chance constraints.

3 - A Risk Mitigation Model for Cyber-attacks to PMU Networks

Seyedamirabbas Mousavian, PhD Candidate, Auburn University, 257 South Gay Street Apt. 201B, Auburn, AL, 36830, United States of America, szm0032@auburn.edu, Jorge Valenzuela, Jianhui Wang

The power grid is dependent on information and communication technologies for the integration of data collected by intelligent measurement devices such as phasor measurement units (PMU). Recent studies have shown that the power grid has significant cyber vulnerabilities which could increase when PMUs are used extensively. In this research, a risk mitigation model is proposed to respond to cyber-attacks to PMU networks. We model the optimal response action as a mixed integer linear programming.

4 - Aggregation of Market Bids in the Smart Distribution System

Mingguo Hong, Associate Professor, Case Western Reserve University, 10900 Euclid Avenue, Glennan Building 321, Cleveland, OH, 44106, United States of America, mxh543@case.edu

Today the RTO electricity markets support demand-side resources through two primary mechanisms: Demand Response (DR) and Price-Responsive Demand (PRD). This study examines the low to medium voltage distribution networks which serve as pathways for Dr. and PRD during operation. A bid aggregation strategy is proposed so that both Dr. and PRD clearings meet the operational constraints of the distribution system. The study addresses the Dr. and PRD impact to local distribution network security.

■ WC57

Level 1 -103D

Routing for Electric Vehicles

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Timothy Sweda, PhD Candidate, Northwestern University, 2145 Sheridan Rd., Rm. C210, Evanston, IL, 60202, United States of America, tsweda@u.northwestern.edu

1 - Optimal Routes for Battery Electric Vehicles Facing Uncertainty: Extensions and Fast Algorithms

Matthew Fontana, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, mfontana@mit.edu, Thomas Magnanti, Dimitris Bertsimas, Oleg Gusikhin, Erica Klampfl, Daniel Reich, Perry MacNeille, Ryan McGee

To address range anxiety for drivers of battery electric vehicles, we propose a robust optimization model to find optimal routes under uncertainty and congestion while considering constraints on total energy. We expand upon previous work by developing and implementing faster algorithms to solve the problem under polyhedral and ellipsoidal uncertainty. In addition, we incorporate effects of acceleration, driver behavior, and traffic conditions into the model.

2 - Optimal and Approximate Algorithms for Energy-efficient Routing of Plug-in Hybrid Electric Vehicles

Mahyar Movahed Nejad, PhD Candidate, Wayne State University, 4815 Fourth St., Detroit, MI, 48202, United States of America, mahyar@wayne.edu, Ratna Babu Chinnam

We introduce the problem of Energy-Efficient Routing for Plug-in Hybrid Electric Vehicles as a new class of the Shortest Path Problem, and model it as both Integer Program (IP) and Dynamic Program (DP). We then prove that the problem is NP-complete, and design optimal and approximate algorithms to solve it. We demonstrate the performance of the proposed algorithms using road network data from Metro Detroit.

3 - Optimal Paths and Recharging Policies for Electric Vehicles in a Network

Timothy Sweda, PhD Candidate, Northwestern University, 2145 Sheridan Rd., Rm. C210, Evanston, IL, 60202, United States of America, tsweda@u.northwestern.edu, Diego Klabjan, Irina Dolinskaya

We consider the problem of finding both a path and recharging policy for an electric vehicle traveling in a network such that the total cost of traveling and recharging is minimized. Charging stations are available at every node, and the vehicle's charge level must remain between upper and lower thresholds along the entire path. We propose efficient solution methods and analyze their performance.

■ WC58

Level 1 -103E

Business Applications

Contributed Session

Chair: Tao Wu, Operations Research Scientist, Apollo Group, 4025 S. Riverpoint Pkwy, Phoenix, United States of America, danielwu9999@gmail.com

1 - A Valuation Model for Tax Loss Carryforwards and Carrybacks

Nilofar Varzgani, Rutgers Business School, 1029, 1 Washington Park, Newark, NJ, 07102, United States of America, nilofarv@pegasus.rutgers.edu, Michael Katehakis, Suresh Govindaraj

We construct a general discrete time model for the valuation tax Loss carryforwards and carrybacks. The model recognizes the institutional aspects of the tax code and it is flexible for many practical applications. Further, the model yields explicit valuation formulas.

2 - Progressive Selection Method for Mixed Integer Programming: Applications and Statistical Analysis

Tao Wu, Operations Research Scientist, Apollo Group, 4025 S. Riverpoint Pkwy, Phoenix, AZ, United States of America, danielwu9999@gmail.com

We develop a new approach, called progressive selection method, which combines exact methods (e.g., column generation) with heuristics, and apply the method to two classes of prominent mixed integer programming problems. Comparisons with other methods indicate that the proposed approach is computationally tractable and is able to obtain competitive results.

■ WC59

Level 1 -103F

Education I: Innovations in Education

Contributed Session

Chair: Martin Kunc, Associate Professor of Management Science, University of Warwick, WBS Social Studies Building, Coventry, CV4 7AL, United Kingdom, martin.kunc@wbs.ac.uk

1 - Lecture Capture Technology and Student Performance in an Operations Management Course

David Lewis, University of Massachusetts Lowell, 1 University Avenue, Manning School of Bus. / OIS Dept., Lowell, MA, 01854, United States of America, David_Lewis@uml.edu, Thomas Sloan

Echo360 and other lecture capture technologies (LCT) have become very popular recently. Several studies show that students favor the use of such technology. But does the use of LCT actually enhance learning outcomes? Using data from an Operations Management course, we study the relationship between lecture capture viewing and learning outcomes.

2 - On the use of Interactive Demonstrations and Visualizations for Quantitative Analysis

Shailesh Kulkarni, University of North Texas, 1155 Union Circle #305, Denton, TX, 76203, United States of America, shailesh.kulkarni@unt.edu, Hakan Tarakci

We have developed a suite of interactive visualizations that cover estimation and hypothesis testing, inventory modeling (including EOQ and the news-vendor model), network optimization and various location/covering models. With the broader goal of sharing our work with the academic community by means of an open portal we also discuss how we deploy cases and hands-on exercise in tandem with our visualizations to create an interesting and immersive learning environment.

3 - Measuring the Impact of OR in Local Economic Development in Developing Countries

Martin Kunc, Associate Professor of Management Science, University of Warwick, WBS Social Studies Building, Coventry, CV4 7AL, United Kingdom, martin.kunc@wbs.ac.uk

OR academic communities can have an important role in social and economic development providing practitioners, academic research or consulting. However, this role has been discussed but not measured formally. The paper presents a framework for measuring the role and impact of OR communities in social and economic development in local communities. The study involves analyzing the OR communities in three Latin American countries and interviews with more than 15 universities

■ WC60

Mezzanine - 100A

Data Mining for Large Data Analysis

Sponsor: Data Mining

Sponsored Session

Chair: Young Seon Jeong, Khalifa University, Abu Dhabi, United Arab Emirates, young.jeong@kustar.ac.ae

1 - A Data-driven Characterization of Residential Energy Consumption

Adrian Albert, PhD Candidate, Stanford University, 350 Serra Mall, Stanford, CA, 94305, United States of America, adalbert@stanford.edu

We develop a dynamic model of residential energy consumption driven by "occupancy states" reflecting structurally different regimes of energy use driven by user presence and activity level such as the use of large appliances (heating, cooling). We learn individual household occupancy models from hourly data for 120,000 energy users in CA. We argue that an understanding of occupancy patterns may be used for targeting Demand-Response programs (e.g., load curtailing) to the right consumers.

2 - Identification and Ranking of Factors that Promote Community Population Changes

Kisuk Sung, Texas A&M University, Dept. of Industrial & Systems Engr., 3131 TAMU, College Station, TX, 77843-3131, United States of America, kisuksung@tamu.edu, Erick Moreno-Centeno, David Matarrita-Cascante, Justin Yates

Previous population change studies which have used statistical regression analyses have multicolinearity between input variables and do not provide the size of the influence of input factors on population change. We introduce decision tree clustering and Cohen's d index in order to identify and rank input factors that contribute to population change in a given community without multicolinearity. We discuss an efficient way to encourage population growth within a given budget or time period.

3 - A Study of the Efficiency and Accuracy of Data Stream Clustering for Large Data Sets

Michael Hahsler, Southern Methodist University, PO Box 750123, Dallas, TX, 75275, United States of America, mhahsler@lyle.smu.edu, Matthew Bolanos

Clustering large data sets is important for many data mining applications. Conventional clustering approaches (k-means, hierarchical clustering, etc.) typically do not scale well for very large data sets. We will investigate the use of data stream clustering algorithms as light-weight alternatives to conventional algorithms on large non-streaming data using several synthetic and real-world data sets.

■ WC61

Mezzanine - 100B

Data Mining II

Contributed Session

Chair: Omid Nohadani, Purdue University, 315 N. Grant St., West Lafayette, IN, 47907, United States of America, nohadani@purdue.edu

1 - Using Visual Analytics to Transform Some Traditional Quality Tools

Huw Smith, Undergraduate Research Assistant, Auburn University, 3301 Shelby Center, Auburn, AL, 36849, United States of America, hds0003@tigermail.auburn.edu, Fadel Megahed

Traditional quality control methods, such as: histogram and defect concentration diagram, were proposed as efficient methods to record and visualize data using paper and pencil. These tools have remained virtually unchanged. In this talk, we highlight how the use of visual analytics can make such tools more informative. We discuss the benefits seen from implementing our approach in an industrial facility. Additionally, we provide a stand-alone application for practitioners.

2 - After Sales Service Transformation in Connected Devices Era

Fei Liu, IBM Research China, Zhongguancun Software Park, Beijing, China, liufeilf@cn.ibm.com, Tao Qin, Qinhua Wang, Changrui Ren

Enabled by new technologies, sold-out devices in the electronics and mechanical industry can now be centrally connected. Manufacturers can have direct communication channels with end customers, and data about customers and devices can be collected online. We argue that after sales service can therefore be transformed from a cost center to a profit source. Maintenance becomes more proactive. Customer behavior can be sensed. New products can be improved. New business models are emerging.

3 - Text Mining via Hierarchical Bayesian Methods: The Case of the Small Samples

Rasim Musal, Assistant Professor, Texas State University, McCoy 458, 601 University Road, San Marcos, TX, 78666, United States of America, mmusal@gmail.com, Cecilia Temponi

This presentation illustrates a fully Bayesian correlated topic model, that was initially proposed by Blei and Lafferty (2007), within the context of Supply Chain Management literature analysis. The small sample approach makes it feasible to apply a Hierarchical Bayesian Model. Focusing on 84 key papers, and a set of pre-identified keywords, we suggest a trend analysis that highlights changes in latent topics. We also discuss various technical issues arising from building a Hierarchical Bayesian model with unknown number of topics.

4 - Algorithms Bring Opinion-pool Forecast Accuracy in Line with Prediction Markets

Pavel Atanasov, Postdoctoral Fellow, University of Pennslyvania, 4525 Pine Street, Apt. 8, Philadelphia, PA, 19143, United States of America, apav@sas.upenn.edu, Emile Servan-Schreiber, Sam Swift, Lyle Ungar, Barbara Mellers, Phillip Rescober, Philip Tetlock

Do prediction markets produce more accurate probability forecasts than competitive opinion-pool methods? In a randomized comparison using 109 political questions, prediction markets significantly outperformed unweighted linear opinion pools. However, probability training, temporal smoothing, elitist weighting and extremizing transformations improved accuracy for opinion pools but not for markets, bringing the two methods to a virtual tie in terms of Brier score, calibration and resolution.

5 - Data-driven Categorization for Maximum Separation and Anomaly Detection

Omid Nohadani, Purdue University, 315 N. Grant St., West Lafayette, IN, 47907, United States of America, nohadani@purdue.edu, Jocelyn Dunn

Data-driven categorization is achieved through iterative comparisons. The presented method defines groups by one data metric to probe if the group distinction also prevails over another metric. The optimal categorizations are achieved by maximum separation between the groups and maximal identification of group anomalies. This approach is free of assumptions on data distribution, and does not require training or pre-defined class labels. The performance is demonstrated on nanoHUB user data.

■ WC62

Mezzanine - 100C

Data Fusion for Manufacturing Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Ran Jin, Virginia Tech, Grado Dept of Industrial and Systems, Engineering, 111 Durham Hall, Blacksburg, VA, 24061, United States of America, jran5@vt.edu

Co-Chair: Jian Liu, The University of Arizona, 915 North Tyndall Avenue, Tucson, AR, 85721, United States of America, jianliu@email.arizona.edu

1 - Modulus Prediction of Poly (Vinyl Alcohol)-Treated Buckypaper Based on Latent Variable Analysis

Kan Wang, Post-Doctoral Fellow, Georgia Institute of Technology, 813 Ferst Dr. NW RM 375, Atlanta, GA, 30332, United States of America, kan.wang@gatech.edu, Arash Pourhabib, Chuck Zhang, Yu Ding, Jianhua Huang, Ben Wang

A finite element (FE) simulation is used to predict Young's modulus of PVA-treated CNT buckypaper. Some input variable in the FE simulation is unobservable in the experiments. A latent variable analysis is developed to combine experiment outputs with simulation results, treating the unobservable variable as latent variable. A formulation for this latent variable analysis problem is presented, and a solution procedure based on non-linear optimization is developed.

2 - Risk Evaluation for System Reliability Demonstration Testing with Reliability Information Fusion

Mingyang Li, Research Assistant, University of Arizona, Tucson, AZ, United States of America, mingyangli@email.arizona.edu, Jian Liu

The large sample size required for demonstrating high system reliability is often unaffordable. To reduce the sample size, existing approaches mainly focus on utilizing a single source of information based on certain risk evaluation criterion. This paper proposes an information fusion approach by systematically utilizing multiple sources of reliability information. Different risk evaluation criteria are analytically compared with the closed-form conditions obtained.

3 - Hierarchical Logistic Regression Model for Crystal Growth Processes

Hongyue Sun, Virginia Tech, Grado Department of Industrial and Syste, m Engineering, 112 Durham Hall, Blacksburg, VA, 24061, United States of America, hongyue@vt.edu, Kaibo Wang, Xinwei Deng, Ran Jin

In semiconductor manufacturing, modeling crystal growth process is crucial for enhancing the initial quality of silicon ingots and all downstream productions. However, such a process modeling poses great challenges due to complex functional data structures. In this work, we propose a hierarchical logistic regression model to address this challenge. Both a simulation and a case study in a continuous crystal growth process are performed to demonstrate the effectiveness of the proposed method.

4 - Surface Variation Modeling for Establishing Cyber-physical Systems in Surface Manufacturing

Hui Wang, Research Scientist, The University of Michigan, 2350 Hayward St., Ann Arbor, MI, 48109, United States of America, huiwz@umich.edu

This talk presents a framework of surface variation modeling for high-precision surface variation control. The proposed methodology fuses the multidisciplinary information from a number of cyber-physical elements in a multistage surface machining process, thereby characterizing the surface variation in interpretable ways. The surface models will enable joint decision making for establishing cyber-physical systems in surface manufacturing.

■ WC63

Mezzanine - 100D

Modeling, Analysis and Prognosis in Service and Manufacturing

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Li Zeng, Assistant Professor, The University of Texas at Arlington, 500 West First Street, Arlington, TX, 76019, United States of America, lzeng@uta.edu

Co-Chair: Qiang Zhou, Assistant Professor, City University of Hong Kong, Dept. of Systems Eng & Eng Mgnt, Kownloon, Hong Kong - PRC, q.zhou@cityu.edu.hk

1 - Robustness and Accuracy of Naive Bayes Classifier for Remaining Useful Life Prediction

Selina Ng, City Univ of Hong Kong, SEEM Dept, City U, 83 Tat Chee Avenue, Kowloon, Hong Kong, Hong Kong, Hong Kong - PRC, selina.ng@my.cityu.edu.hk, Kwok-Leung Tsui

This paper investigates the use of a popular data-driven classifier in the state-of-health prognostics of Lithium-ion battery. The theory, methodology, and performance of naive Bayes in remaining useful life prediction over time are studied. An empirical procedure is presented and applied to publicly available battery data, and the performance of naive Bayes in terms of both accuracy and robustness is compared to another popular method, support vector machine.

2 - Prediction of the Failure Interval with Maximum Power Based on Remaining Useful Life Distribution

Junbo Son, University of Wisconson, Madison, WI, United States of America, json5@wisc.edu, Mutasim Salman, Shiyu Zhou, Qiang Zhou

Prognosis of remaining useful life (RUL) of a unit or a system plays an important role in system reliability. One key aspect of the RUL prognosis is constructing the best prediction interval. In this paper, we propose a new method, namely maximum prediction power interval (MPI). The MPI guarantees the best prediction performance under the given acceptable error range. A numerical simulation study and case study with real data confirm the better features of MPI over existing prediction intervals.

3 - Modeling, Analysis, and Improvement of Multi-product Manufacturing Systems

Cong Zhao, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, czhao27@wisc.edu, Jingshan Li

This presentation analyzes the multi-product manufacturing systems consisting of unreliable exponential machines and finite buffers. In such systems, multiple product types are processed in a predetermined sequence with different speeds on all machines. Buffers have finite capacities, and are shared for all products. Analytical methods to analyze the system performance are developed. Bottleneck analysis is carried out to identify the machine or product that will lead to the largest improvement.

■ WC64

Mezzanine - 100E

Reliability: Data Mining

Contributed Session

Chair: Huizhu Wang, Georgia Tech, 765 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, hwang8@gatech.edu

1 - Statistical Equivalency and Optimality of Accelerated Life Testing Plans under Type-I Censoring

David Han, Assistant Professor, University of Texas at San Antonio, One UTSA Circle, San Antonio, TX, 78249, United States of America, david.han@utsa.edu

Running a test at higher stress than normal, accelerated life testing (ALT) quickly yields information on lifetime distribution. In constant-stress ALT, unit is tested at a fixed stress level while step-stress ALT allows increasing stress levels at some fixed points. On the other hand, stress is linearly increased for progressive-stress ALT. In this talk, statistical equivalency and optimality of k-level life-tests are discussed for exponential distribution under Type-I censoring.

2 - SPC Monitoring on Waveform Profiles without Gold Standard Profile Exist

Shih-Hsiung Chou, Kansas State University, 237 Durland Hall, Manhattan, KS, 66506, United States of America, cls3415@ksu.edu, Shing I Chang

Manufacturing high-pressure hose products will produce condensation water temperature profiles during the curing process. The waveform shape profiles have no gold standard reference exist to represent an in-control state of this process. The proposed statistical process control approach applies fast Fourier transformation, partition around medoids clustering method, support vector machine classifier, and IX control chart to monitor if the condensation water valve and water level in the chamber.

3 - Reliability Analysis and Prediction from Field Warranty Database

Shah Limon, GRA, North Dakota State University, 209 University Village, Fargo, ND, 58102, United States of America, shah.limon@ndsu.edu, OM Yadav, Nitendra Gautam

The field warranty data contains certain amount of uncertainty and incompleteness, but still a good source of information about actual product behavior and performance. In this work, industrial loader warranty data is analyzed to determine the product reliability. This product reliability can be efficiently used to improve the design of next generation products.

4 - Monitoring Nonlinear Profiles Adaptively with a Wavelet-Based Distribution-Free CUSUM Chart

Huizhu Wang, Georgia Tech, 765 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, hwang8@gatech.edu, Seong-Hee Kim

In order to detect a shift in the mean of high-dimensional profiles with generally distributed noise, we present a wavelet-based distribution-free tabular CUSUM chart with an adaptive threshold. Experimental results show this new chart is effective and can detect shifts that other control charts miss.

■ WC65

Mezzanine - 100F

Operations Management in Manufacturing

Contributed Session

Chair: Arman Sabbaghi, Harvard University Department of Statistics, 1 Oxford Street, 7th Floor, Cambridge, MA, 02138, United States of America, sabbaghi@fas.harvard.edu

1 - An ACE Analysis of SCM/JIT/TOC and Manufacturing Performance in USA, Japan, Germany, and Italy

James Ang, Associate Professor, National University of Singapore, BIZ 1, 8-4, 15 Kent Ridge Drive, Singapore, 119245, Singapore, bizangsk@nus.edu.sg, Ian Gobardja, Tomoaki Shimada, Sir-Aik Quek

We studied the impact of supply chain management, just-in-time and theory of constraints on manufacturing performance in countries known for their manufacturing excellence. The three determinants are conceptually linked and can be considered as components of a bigger whole. Using data from the High Performance Manufacturing project, we applied the Alternating Conditional Expectations techniques to unravel nonlinear relationship among them.

2 - Steady State Characteristics under Processing-time Learning and Forgetting

Sunantha Teyarachakul, Dr., MacEwan University, Rm 5-256D, 10700-104 Avenue, Edmonton, AB, T5J 4S2, Canada, teyarachukals@macewan.ca

We study long-term characteristics of batch production times in an environment where workers learn while producing units within a batch, forget during the interruption in productions, and relearn when returning to production of a product. We assume an infinite-horizon, a constant demand-rate and a fixed lot-size. The specific classes of forgetting models under our examinations include power forgetting and exponential forgetting functions, and the generalized model.

3 - NK Fitness Landscapes to Optimize Genetic Algorithms for Flexible Manufacturing System Scheduling

Ashkan Negahban, Instructor and PhD Student, Auburn University, 3334 Shelby Center, Auburn University, Auburn, AL, 36849, United States of America, anegahban@auburn.edu, Levent Yilmaz

Incorporating knowledge about the search space is crucial to the performance of metaheuristics. In this paper, through extensive simulation, we solve several sample FMS scheduling problems and extract different statistical information to characterize the structure of the solution space. The NK model is then used to generate similar landscapes that resemble the search space for the problem which are then used to design genetic algorithms capable of searching the solution space more efficiently.

4 - A Cost-effective Replenishment Optimization Method for Fast Fashion Enterprises

Xiao Qing Wang, PhD, IBM, Dongbeiwang West Road, Ring 2#, Beijing, China, xqwangxq@cn.ibm.com, Ding Ding Lin, Yong Qing Xue, Gang Gang Niu, Hong Wei Ding

The supply chain of fast fashion enterprises is facing great challenge to support its rapid expansion and handle the change from supply driven to demand driven. Fast fashion enterprises urgently need to convert such a challenge into opportunity through a highly effective replenishment mechanism. A replenishment optimization method driven by intelligent sales forecasting and cost-effective business rules for fast fashion enterprises is addressed and proposed.

5 - Inference with Interference and Interference for Inference in a 3D Printing Experiment

Arman Sabbaghi, Harvard University Department of Statistics, 1 Oxford Street, 7th Floor, Cambridge, MA, 02138, United States of America, sabbaghi@fas.harvard.edu, Tirthankar Dasgupta, Qiang Huang, Jizhe Zhang

In complex engineering processes, such as 3D printing, properly defining experimental units and understanding interference are critical for quality control. We investigate interference between regions of a 3D printed product with experiments involving the application of discontinuous compensation plans for correcting product deformations. Our treatment illustrates both a useful strategy for modeling interference, and complications arising for products having discontinuous compensation plans.

■ WC66

Mezzanine - 100G

Issues in Multi-channel Advertising and Retail

Sponsor: Information Systems

Sponsored Session

Chair: Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 4800 Forbes Avenue, Hamburg Hall, Pittsburgh, Pe, 15213, United States of America, vibs@andrew.cmu.edu

1 - Television Advertising and Online Search

Mingyu (Max) Joo, Assistant Professor, The Ohio State University, 2100 Neil Ave., Columbus, OH, 43210, United States of America, joo.85@osu.edu, Ken Wilbur, Bo Cowgill, Yi Zhu

Despite a 20-year trend toward integrated marketing communications, advertisers seldom coordinate TV and search ad campaigns. We find that TV ads for financial services brands increase both the number of related Google searches and searchers' tendency to use branded keywords in place of generic keywords. The elasticity of a brand's total searches with respect to its TV advertising is .17, an effect that peaks in the morning.

2 - Marketing Attribution in a Multichannel Customer Relationship Setting

Marcel Goic, Assistant Professor, University of Chile, Chile, mgoic@dii.uchile.cl, Kirthi Kalyanam, Kinshuk Jerath

In this research we explore how a multichannel contact with the customer affects her likelihood of making a purchase and how much attribution should be given to each touch point. We propose a parsimonious model where the propensity to buy and use each channel is mediated by latent inventories of information which accumulate as the customer get in contact with the firm. Empirical results using data from an online retailer suggest that the channels play different roles in the purchase process.

3 - Multi-channel Retailing: The Value of Online Channel

Ashish Agarwal, McCombs School of Business, UT Austin, Austin, TX, 78759, United States of America, ashish.agarwal@mccombs.utexas.edu

We consider a panel of publicly traded US dual channel retailers and evaluate how their online and offline business impacts their Tobin's q. We find that the market only values the offline growth and not the online growth for dual channel retailers. We also find that several online features help offline sales which justifies the value of online channel for a multi-channel retailer.

4 - Integration of Online and Offline Channels in Retail

Antonio Moreno-Garcia, Kellogg School of Management. Northwestern University, Evanston, IL a-morenogarcia@kellogg.northwestern.edu, Santiago Gallino

Increasingly, retailers are integrating their offline and online channels to reduce costs or to improve the value proposition they make to their customers. Using data from a leading online retailer of eyewear, we study the effect of opening brick and mortar showrooms to display inventory that can be ordered online.

■ WC67

Mezzanine - 100H

Decision Models for Adaptive Adversaries

Sponsor: Decision Analysis

Sponsored Session

Chair: Richard John, Associate Professor, University of Southern California, Department of Psychology, MC-1061, Los Angeles, CA, 90089-1061, United States of America, richardj@usc.edu

1 - Adaptive Adversary Modeling - A Predictive Modeling Perspective

Seth Guikema, Assistant Professor, Johns Hopkins University, Baltimore, MD, United States of America, sguikem1@jhu.edu

Adaptive adversary modeling is an integral part of intelligent adversary risk analysis. An adaptive adversary model aims to model the behavior of the adversary in response to defender actions. Is this a predictive exercise? Should it be? This talk examines adaptive adversary modeling from a predictive modeling perspective, providing an assessment of whether or not is desirable, and if so, feasible, for adaptive adversary models to be predictive models.

2 - A Robust Stackelberg Solution Against Boundedly Rational Followers

Albert Xin Jiang, University of Southern California, Dept of Computer Science, Los Angeles, CA, 90089, United States of America, albertjiang@gmail.com, Thanh Nguyen, Milind Tambe, Ariel Procaccia

There has been recent interest in applying Stackelberg games to security, in which a defender must protect targets from attack by an adaptive adversary. In real-world settings the adversaries are boundedly rational. Most existing approaches try to optimize against specific behavioral models of adversaries, and are not robust against modeling errors. We propose a robust optimization approach, which provides guarantees against all adversary behavior satisfying certain regularity properties.

3 - Attacker-defender Games with Partially-concave-Partially-convex (PC^2) Contest Success Functions

Peiqiu Guan, PhD Student, University at Buffalo, 338 Bell Hall, Buffalo, NY, 14260, United States of America, peiqiugu@buffalo.edu, Jun Zhuang, Stephen Hora

When the defense and attack efforts are continuous, contest success functions (CSFs) are used to model the probability of a successful attack as a function of the defender and the attacker investment. Most CSFs in the literature assume diminishing marginal returns, which may not hold in practice when the investments are small. We use a class of partially-concave-partially-convex CSFs to model such "warm-up" effects, and study the impact of such effects on equilibrium attack and defense efforts.

4 - Combined MAU and SOFTMAX Modeling of Uncertainty in Adversary Behavior

Richard John, Associate Professor, University of Southern California, Department of Psychology, MC-1061, Los Angeles, CA, 90089-1061, United States of America, richardj@usc.edu, Heather Rosoff

We present case studies using proxy adversary values experts to model uncertainty in adversary attack behavior. Multiple adversary values expert assessments are used to compare different adversary groups and different assessments for the same adversary group. We use these models to assess the effectiveness of different counter terrorism in changing the likelihood of particular adversary attacks.

■ WC68

Mezzanine - 100I

Operations Decision Support

Sponsor: Decision Analysis

Sponsored Session

Chair: Barry Cobb, Virginia Military Institute, 334 Scott Shipp Hall, Economics and Business, Lexington, VA, 24450, United States of America, cobbbr@vmi.edu

1 - Optimization of Tanker Capacity under Uncertain Demand and Lost Sale

Nikoo Sabzevar, PhD Student - Research Assistant, University of Calgary, 2500 University Dr. NW, Calgary, AB, T2N 1N4, Canada, nikou.sabzevar@ucalgary.ca, Van Enns, Janne Kettunen, Joule Bergerson

There has been considerable growth in LNG export demand for a few decades; however, there is limited work in determining optimal tanker sizes and numbers for maritime LNG transport under uncertainty. An optimization model and a heuristic algorithm were developed to maximize expected profit under probabilistic demand with the option of lost sales. Preliminary results indicate lost sales and the optimal number of tankers increase with increased demand uncertainty.

2 - The Impact Utility Function has on the Retailer's and Supplier's Operational Strategies

Candice Huynh, University of California, Irvine, Paul Merage School of Business, Irvine, CA, 92697-3125, United States of America, candich@uci.edu, Wenting Pan

We examine the relationship between one retailer and one manufacturer engaging in a Vendor Managed Inventory contract. The manufacturer is risk-neutral and so his objective is to maximize his expected profit, while the retailer exhibits risk preferences, and therefore maximizes her expected utility. Using the expected utility theory framework, we compare the retailer's utility under the VMI contract to the traditional newsvendor setting.

3 - Solving Multistage Decision Problems by Discretization Method

Yijing Li, University of Kansas, 1300 Sunnyside Ave., Lawrence, KS, 66045, United States of America, yjl@ku.edu

Large sequential decision problems with continuous probability distributions are usually intractable. The simplest case of multistage decision problems is the Markov Decision Process (MDP). In this paper, we propose using discretization method to solve MDPs. We can obtain optimal strategy by using interpolation. We will illustrate the method by some examples.

■ WC69

Mezzanine - 100J

Behavioral Operations in Business Management

Contributed Session

Chair: Yi-Su Chen, Assistant Professor, University of Michigan-Dearborn, 19000 Hubbard Drive, FCS 184, Dearborn, MI, 48126, United States of America, yisuchen@umich.edu

1 - Priming, Risk Aversion and Newsvendor Ordering Behavior

Sebastian Villa, Universit‡ della Svizzera italiana (USI, Lugano), Via Giuseppe Buffi 13, Lugano, 6904, Switzerland, villabes@usi.ch, Jaime Andrés Castañeda

Behavioral work studying de-biasing strategies for Newsvendor ordering decisions has focused mainly on addressing flat maxima and outcome feedback quality concerns. We propose the priming effect as an instrument to adjust risk attitudes in order to promote either risk seeking or risk averse behaviors. According to both the nature of the priming and the profitability condition, the adjusted risk attitude will lead to either a reduction or an increase in biased ordering behavior.

2 - Economic Implications of Consumer Fairness Concerns

Xiaomeng Guo, Washington University in St. Louis, Campus Box 1133, One Brookings Drive, Saint Louis, MO, 63130, United States of America, xiaomeng.guo@wustl.edu, Baojun Jiang

Consumers with inequity aversion experience some psychological disutility when buying products at unfair prices. We show that a firm's optimal quality may be non-monotone in the degree of consumers' inequity aversion. Stronger inequity aversion may benefit a firm and lead to lower monetary payoffs for consumers. Interestingly, as the average cost-efficiency in the market decreases, both the expected quality and social welfare may increase rather than decrease.

3 - A Tale of Two Perspectives: A Dyadic View of Buyer Behaviors

Yi-Su Chen, Assistant Professor, University of Michigan-Dearborn, 19000 Hubbard Drive, FCS 184, Dearborn, MI, 48126, United States of America, yisuchen@umich.edu, Hung-Chung Su, Young Ro

A simple two-player game assumes that prior to decision making, either player will evaluate the other player's options, anticipate the other player's decisions, and respond. While it is logical and common to apply game theory to study buyer-supplier relationships, game theory can be used to its full potential if the anticipation of an opponent's behavior is accurate. This study explores conditions wherein suppliers can accurately anticipate buyers' behaviors. Implications are discussed.

Wednesday, 3:30pm - 5:00pm

■ WD01

Level 2 - Room 200A

High-frequency Trading and Market Microstructure

Cluster: Optimization in Finance

Invited Session

Chair: Gerry Tsoukalas, University of Pennsylvania, Wharton School, Philadelphia, PA, United States of America, gtsouk@wharton.upenn.edu

Co-Chair: Ciamac Moallemi, Associate Professor, Columbia University, 3022 Broadway Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

1 - Double-Sided Batch Queues with Abandonment: Modeling Crossing Networks

Adam Diamant, PhD Candidate, University of Toronto, Rotman School of Management, 105 St. George Street, Toronto, ON, M5S 3E6, Canada, Adam.Diamant09@Rotman.Utoronto.ca, Joseph Milner, Philipp Afeche

Crossing networks are increasingly important in the operation of modern financial markets. We model these as double-sided batch arrival queues with abandonment. We derive closed-form expressions for the fill rate and system time and present a sensitivity analysis that compares our model with simulation results. We investigate how the performance measures are affected by customers with different order size distributions, counterparty preferences and a mix of patient/impatient customer types.

2 - Optimal VWAP Tracking

Daniel Mitchell, University of Texas, McCombs School of Business, Austin, TX, United States of America, daniel.mitchell@phd.mccombs.utexas.edu, Stathis Tompaidis, Jedrzej Bialkowski

We consider the problem of finding a strategy that tracks the volume weighted average price (VWAP) of a stock. We obtain the optimal, dynamic, VWAP tracking strategy in closed form in a model without trading costs with general price and volume dynamics. We build a model of intraday volume using the Trade and Quote data set to empirically test the strategy, both without trading costs and when trading has temporary and permanent effects.

3 - Limit Order Queue with Heterogeneous Traders

Arseniy Kukanov, Columbia University, Ithaca, NY, United States of America, ak2870@columbia.edu, Costis Maglaras

In financial markets, heterogeneous agents trade in an order book, which can be modeled as a queueing system. Empirical data shows exceptionally long waiting times for orders in large queues and anomalous bursts of cancelations from small queues. To describe this behavior we develop a multiclass model for an order queue at the best bid (ask) of an exchange. Our model can explain empirical waiting time observations and it sheds light on the composition of limit order queues.

■ WD02

Level 2 - Room 200B

First Order Method and Tensor Optimization

Sponsor: Optimization/Nonlinear Programming

Sponsored Session

Chair: Bo Jiang, PhD Student, ISyE, University of Minnesota, 111 Church Street SE, Minneapolis, United States of America, jiang373@umn.edu

1 - On the Matrix Rank of Even-Order Tensors and Its Application in Low-Rank Tensor Optimization

Bo Jiang, PhD Student, ISyE, University of Minnesota, 111 Church Street SE, Minneapolis, United States of America, jiang373@umn.edu, Shiqian Ma, Shuzhong Zhang

In this paper, we propose to unfold an even-order tensor into a matrix, whose row index is formed by one half of the indices of the tensor and column index is formed by the other half. The rank of the resulting matrix has many interesting properties. For instance, the original tensor rank can be both lower and upper bounded by the matrix rank multiplied by a constant depending on dimension n. Our numerical results show that this matrix rank is useful in low-rank tensor optimization problems.

2 - Tensor Principal Component Analysis via Convex Optimization

Shiqian Ma, Assistant Professor, The Chinese University of Hong Kong, Room 508, William M.W. Mong Engineering, Shatin, N.T., Hong Kong - PRC, sqma@se.cuhk.edu.hk, Bo Jiang, Shuzhong Zhang

We show that in a general tensor PCA problem, the tensor can be embedded into a symmetric matrix. We prove that if the tensor is rank-one, then the embedded matrix must be rank-one too, and vice versa. The tensor PCA problem can thus be solved by means of matrix optimization under a rank-one constraint. We propose two convex relaxations for the rank-one constrained problem. Our numerical results show that both relaxations produce rank-one solutions with high probability.

3 - Solving Multiple-Block Separable Convex Minimization Problems using Two-Block ADMM

Xiangfeng Wang, Ph.D. student, Department of Mathematics, Nanjing University, 22 Hankou Road, Nanjing, JS, 210093, China, xfwang.nju@gmail.com

In this paper, we consider solving multiple-block separable convex minimization problems using alternating direction method of multipliers (ADMM). Motivated by the fact that the existing convergence theory for ADMM is mostly limited to the two-block case, we analyze in this paper, both theoretically and numerically, a strategy that first transforms a multi-block problem into an equivalent two-block problem.

4 - Recovering Low CP/Tucker Ranked Tensors, with Applications in Tensor Completion

Shaozhe Tao, Ph.D. student, ISyE, University of Minnesota, 2508 Delaware St. SE, APT123A, Minneapolis, MN, 55414, United States of America, taoxx120@umn.edu, Bo Jiang, Shuzhong Zhang, Xiang Gao

We propose a method to find tensor decompositions with low CP/Tucker rank. In our approach, no prior knowledge of tensor rank is assumed. The key idea is to recover a group sparsity structure. The problem reduces to multi-block optimization. Two solution methods proposed are Block Coordinate Decent (BCD) and Maximum Block Improvement (MBI). We also use our method to solve the tensor low-rank completion problem. Simulation results show that our new method performs well numerically.

■ WD03

Level 2 - Room 200C

Integer Programming Models and Methods for Routing

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Alejandro Toriello, Assistant Professor, University of Southern California, 3715 McClintock Ave., GER 240, Los Angeles, CA, 90089, United States of America, toriello@usc.edu

1 - On Traveling Salesman Games with Asymmetric Costs

Nelson Uhan, Assistant Professor, United States Naval Academy, Chauvenet Hall, Annapolis, MD, 21402, United States of America, uhan@usna.edu, Alejandro Toriello

We study cooperative traveling salesman games with asymmetric costs. We construct a stable cost allocation with budget balance guarantee equal to the Held-Karp integrality gap for the asymmetric traveling salesman problem, using a new variant of the Held-Karp relaxation and a previously unknown connection to linear production games. We provide examples in which stable cost allocations necessarily have poor budget balance guarantees, and discuss their implications on future work.

2 - A Comparison Between DP-based Bounds for the TSP

Ricardo Fukasawa, Associate Professor, University of Waterloo, 200 University Avenue West, Waterloo, N2L3G1, Canada, rfukasaw@math.uwaterloo.ca, David Qian

In this talk, we present two different families of formulations for the Traveling Salesman Problem (TSP). One is based on a Branch-and-cut-and-price approach (BCP) and the other one based on Approximate Linear Programming formulations (ALP) for the shortest path TSP formulation. Both of these bounds are defined in terms of a parameter t which gives a tradeoff between formulation size and bound quality. Our results show that the BCP_{t+1} dominate the ALP_t bound for any t.

3 - A Dynamic Programming-based Branch-and-Bound Heuristic for Traveling Salesman Problems

Michael Poremba, Ph.D. Student, University of Southern California, 3715 McClintock Ave. GER240, Los Angeles, CA, United States of America, poremba@usc.edu

We present a dynamic programming-based branch-and-bound heuristic for variants of the traveling salesman problem (TSP), including the time-dependent TSP and the prize-collecting TSP. We construct tours dynamically, using different bounds to guide our decisions. By building a search tree, we can backtrack to explore other potential solutions. We will discuss the computational challenges of implementing both an exact and a heuristic algorithm, along with results from computational experiments.

4 - Equivalence of an Approximate Linear Programming Bound with the Held-Karp Bound for the TSP

Alejandro Toriello, Assistant Professor, University of Southern California, 3715 McClintock Ave., GER 240, Los Angeles, CA, 90089, United States of America, toriello@usc.edu

We consider two relaxations of the asymmetric traveling salesman problem (TSP), the Held-Karp relaxation of the TSP's arc-based formulation, and an approximate linear programming (ALP) relaxation obtained by restricting the dual of the TSP's shortest path formulation. We show that the two formulations produce equal lower bounds for the TSP's optimal cost. We then show how the ALP formulation can be modified to yield a relaxation for several TSP variants.

■ WD04

Level 2 - Room 200D

Computational Aspects of Mixed-integer Programming

Sponsor: Optimization/Integer Programming

Sponsored Session

Chair: Gustavo Angulo, Georgia Tech, Atlanta, GA, United States of America, gangulo@gatech.edu

1 - Concurrent Root Cut Loops to Exploit Random Performance Variability

Andrea Tramontani, IBM Italy, CPLEX Optimization, Via Martin Luther King 38/2, Bologna, 40132, Italy, andrea.tramontani@it.ibm.com, Matteo Fischetti, Andrea Lodi, Domenico Salvagnin, Michele Monaci

Performance variability is a well known issue in Mixed Integer Programming. We propose a possible way to exploit random variability at the root node of a branch-and-cut algorithm, by performing multiple root cut loops in a parallel fashion. The idea is to enforce some random diversification in the alternative cut loops, in order to collect more cutting planes and a (possibly) better incumbent solution. We provide benchmark results to analyze the performance impact of the proposed approach.

2 - Interesting Use Cases for the CPLEX Remote Object

Laszlo Ladanyi, IBM, 11 Interlaken Rd., Lakeville, CT, 06039, United States of America, ladanyi@us.ibm.com, Daniel Junglas

CPLEX 12.5 has introduced the CPLEX Remote Object. In this presentation we discuss ways to employ remote objects in order to design powerful distributed algorithms like decomposition based approaches without having to worry about details of the communication between the machines.

3 - Facet-defining Valid Inequalities for Constant-batch and Multi-module Capacitated Lot-sizing Problem

Manish Bansal, PhD Student, Texas A&M University, TAMU 3131, College Station, TX, 77843, United States of America, bansal@tamu.edu, Kiavash Kianfar

We provide the necessary and sufficient conditions under which the valid inequalities derived using the mixing procedure of Günlük and Pochet (2001) and (k,l,S,I) inequalities of Pochet and Wolsey (1993) are facet-defining for the constant-batch lot-sizing problem. We also derive sufficient conditions for mixed n-step MIR inequalities of Sanjeevi and Kianfar (2012) to be facet-defining for multi-module lot-sizing problem (MML) and present an extended formulation for MML with Wagner-Whitin costs.

4 - On a Generalization of the Splittable Flow Arc Set

Sanjeeb Dash, Research Staff Member, IBM Research, 1101 Kitchawan Rd., Yorktown Heights, NY, 10598, United States of America, sanjeebd@us.ibm.com, Oktay Gunluk, Laurence Wolsey

We study a generalization of the single facility splittable flow arc set which was studied by Magnanti et. al. (1993), who obtained the facial structure of the convex hull of this set. A simple separation algorithm for this set was later given by Atamturk and Rajan. The set is defined by a single capacity constraint, one nonnegative integer variable and any number of bounded continuous variables. We generalize this set by considering two integer variables and give its convex hull.

■ WD05

Level 2 - Room 200E

Large Scale Optimization

Contributed Session

Chair: Mengdi Wang, Massachusetts Institute of Technology, 35 Plymouth St., Cambridge, MA, 02141, United States of America, mdwang@mit.edu

1 - Loosely Coupled Singular Value Decomposition Computations and Applications in Optimisation Problems

Sheng Fang, University of Oxford, Pembroke College, Oxford, OX1 1DW, United Kingdom, fang@maths.ox.ac.uk, Raphael Hauser

The emergence of novel computational architectures, such as multi-core processors and graphic cards, makes it increasingly important to develop new numerical linear algebra algorithms to harness the available computational power. We discuss such a loosely coupled algorithm with low synchronicity, low communication overhead for the computations of a leading part singular value decomposition of very large, not necessarily sparse, matrices. Applications in optimisation problems are also presented.

2 - MINLP with Combined Interior Point and Active Set Methods

John Hedengren, Assistant Professor, Brigham Young University, 350 CB, Provo, UT, 84602, United States of America, john.hedengren@byu.edu, Jose Mojica, Sarah Nikbakhsh

The APOPT and BPOPT solvers combine the active set and interior point methods to improve the speed and convergence of subproblems in the branch and bound approach to Mixed Integer Nonlinear Programming (MINLP). The strength of an active set method is in quickly finding solutions from nearby branches while the strength of an interior point method is in problems with many degrees of freedom or where the active set is not known. Details of integration at the LP/QP and NLP levels are provided.

3 - Streaming Convex Hulls: Experimental Results

Jose Dula, Virginia Commonwealth University, Snead Hall, Richmond, VA, United States of America, jdula@vcu.edu, Francisco Lopez

In the streaming framework, points are tested before inclusion into the point set. The convex hull has to be recalculated if the streamer is external. An elegant algorithm was designed from new geometric insights and strong theoretical results. Our experiments demonstrate that the new algorithm has the potential to reduce substantially computational times in a streaming setting.

4 - Approximation of Euclidean Norm by LP-representable Norms and Applications

Jun-ya Gotoh, Associate Professor, Chuo University, 1-13-27 Kasuga, Bunkyo-ku, Tokyo, Japan, jgoto@indsys.chuo-u.ac.jp, Stan Uryasev

We study norms whose minimization can be formulated as single linear programs. Among such are the CVaR norm (aka the D-norm (Bertsimas et al., 2004)) and its dual. Both can be shown to equivalently well approximate the L2-norm in some sense. Besides, the convex combination of the L1- and max-norms and its dual norm are shown to do better. The analysis also implies that as dimension grows, the four norms are tilted toward the max-norm rather than L1-norm to better approximate the L2-norm.

5 - Random Incremental Methods for Large-scale Convex Optimization

Mengdi Wang, Massachusetts Institute of Technology, 35 Plymouth St., Cambridge, MA, 02141, United States of America, mdwang@mit.edu, Dimitri Bertsekas

We consider stochastic methods for large-scale convex optimization with complicated constraints. We propose new methods that combine elements of constraint sampling, stochastic gradient and proximal algorithm, which are suitable for applications involving distributed implementation, large data set, or online learning. We use a unified analytical framework to show that their convergence involves an interplay between two coupled processes with different rates of convergence.

■ WD06

Level 2 - Room 200F

Network Analysis and Resilient Systems

Sponsor: Optimization/Networks

Sponsored Session

Chair: Xin Chen, Assistant Professor, Southern Illinois University-Edwardsville, PO Box 1805, Industrial and Manufacturing Engineering, Edwardsville, IL, 62026-1805, United States of America, xchen@siue.edu

1 - A Resilience Framework for Collaborative Supply Networks

Rodrigo Reyes Levalle, Purdue University, 315 North Grant St., West Lafayette, IN, United States of America, rreyesle@purdue.edu, Shimon Nof

Research on resilient design and operation of supply networks is at its early stages; existing approaches are based on a trade-off between costs and fault-tolerance. The Fault Tolerance by Teaming (FTT) principle of Collaborative Control Theory appears as a promising solution, not based on the aforesaid trade-off. An FTT-inspired Resilience Framework for Supply Networks is presented and applied in two case studies; results are compared to those of traditional approaches for resilience.

2 - Improving Reverse Logistics Network for Medical Waste by Neural Networks and Genetic Algorithms

Hoo Sang Ko, Assistant Professor, Southern Illinois University Edwardsville, SIUE Box 1805, Edwardsville, IL, 62026, United States of America, hko@siue.edu, Samira Arabgol, Sasan Hejrani

Prompt and proper management of medical wastes are critical due to the potential hazards to health and environment. This study aims at improving the performance of the reverse logistics network for medical waste management to minimize the risks. First, we predict the amount of waste generated at medical centers using an artificial neural network. Second, we optimize the distribution of the waste in the network using a genetic algorithm. The methodology is validated by an illustrative example.

3 - Preventative Maintenance of Water Distribution Systems

Yonatan Gebre, Southern Illinois University, Edwardsville IL, United States of America, jgebre@gmail.com, Xin Chen, Honggang Wang, Yada Zhu

Water distribution systems (WDS) are a type of spatially organized systems in which components (nodes) are connected by pipes (links). To control a WDS with limited resources, critical nodes and links are identified for maintenance using efficient algorithms. Simulation optimization is applied to validate the algorithms.

4 - Multidimensional Assignment Problems: Graph Theoretic and Integer Programming Heuristics

Chrysafis Vogiatzis, Ph.D. Student, University of Florida, Weil 303, Gainesville, FL, 32608, United States of America, chvogiat@gmail.com, Panos Pardalos

The Multidimensional Assignment Problem (MAP) is a well-known NP-hard problem, which is often used to model multi-sensor multi-target, and data association problems. In this presentation, we propose two novel decomposition schemes, employing the Augmented Lagrangian, and a graph-theoretic description of the problem to solve it heuristically. Computational results will be presented to contrast our results to the state-of-the-art.

■ WD07

Level 2 - Room 200G

Applications of Stochastic Programming in Energy and Industry

Sponsor: Optimization/Stochastic Programming

Sponsored Session

Chair: Urmila Diwekar, President, Vishwamitra Research Institute, 368 56th Street, Clarendon Hills, IL, 60514, United States of America, urmila@vri-custom.org

1 - Case Study: Network Optimization Planning under Uncertainty

Amy David, University of Illinois at Chicago, 1615 Monroe Street, #1S, Evanston, IL, 60202, United States of America, amydavid@uic.edu, Urmila Diwekar

We present a case study of a large-scale stochastic optimization problem for a manufacturer with plants and customers throughout North America seeking to minimize total delivered cost (including production, handling, and freight), subject to capacity constraints and uncertainties in both demand and costs.

2 - Relaxations for Stochastic Unit Commitment

John Birge, University of Chicago, Booth School of Business, 5807 South Woodlawn Avenue, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Mihai Anitescu, Cosmin Petra

Stochastic unit commitment problems can be modeled as stochastic mixed-integer programs but these models can easily become intractable. This talk will discuss relaxations in which binary decisions are interpreted as probabilities and constraints are placed on variance.

3 - Modeling Transmission Line Constraints in Two-stage Robust Unit Commitment Problem

Changyeok Lee, Graduate Student, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, changhyeok.lee@u.northwestern.edu, Cong Liu, Kibaek Kim

Integration of renewable energy sources and demand response poses new challenges as they increase the uncertainty of the power supply and demand. We present an acceleration technique for solving two-stage robust unit commitment models by dynamically including critical transmission line constraints. Computational results for the modified IEEE-118 bus system show that the proposed cutting-plane algorithm improves the solution speed, but the column-generation algorithm is not effective.

4 - BONUS Algorithm for Large Scale Stochastic Nonlinear Programming Problems in Energy Systems

Urmila Diwekar, President, Vishwamitra Research Institute, 368 56th Street, Clarendon Hills, IL, 60514, United States of America, urmila@vri-custom.org

In this work, we present the Better Optimization of Nonlinear Uncertain Systems (BONUS) algorithm for large scale stochastic nonlinear programming problems. Applications are presented from the energy sector. These include sensor placement in power plants, real time optimization for water management in power plants, and stochastic optimization of biofuel manufacturing.

■ WD08

Level 2 - Room 200H

Vehicle Routing

Sponsor: Computing Society

Sponsored Session

Chair: Sam Thangiah, Professor, Slippery Rock University, Artificial Intelligence and Robotics Lab, 250 ATS, Slippery Rock, PA, 16057, United States of America, sam.thangiah@sru.edu

1 - Determining Approximate School Buses Required for a School District using Population Data

James Mullen, Slippery Rock University, Artificial Intelligence and Robotics Lab, 250 ATS, Slippery Rock, PA, 16057, United States of America, jjm1252@sru.edu, Sam Thangiah, Shane Chestnutt, Daniel Arnett

This study describes how population and road network data available from the U.S. Census Bureau were used to determine the approximate number of school buses required to transport regular students in a school district. We describe the results obtained for eight school districts in the state of Pennsylvania.

2 - The Stochastic Repeated Fleet Size and Vehicle Routing Problem

Urooj Pasha, Høgskolen i Molde, Specialized University in Logistics, PO Box 2110 N-6402, Molde, Norway, urooj.pasha@himolde.no, Arild Hoff, Arne Løkketangen

A new variant of the Fleet size and Mix Vehicle Routing Problem (FSMVRP) named as The Stochastic Repeated Fleet Size and Mix Vehicle Routing Problem (SR-FSMVRP) is introduced and defined in this paper. It is a non deterministic delivery problem. Different scenarios are generated with stochastic demand for a given set of customers. The objective is to find the solution with the lowest expected transportation cost for a given time period.

3 - Routing Autonomous Aerial Vehicles Away from Populated Regions using Road Network Data

Sam Thangiah, Professor, Slippery Rock University, Artificial Intelligence and Robotics Lab, 250 ATS, Slippery Rock, PA, 16057, United States of America, sam.thangiah@sru.edu, James Mullen, Shawn Forsythe, Daniel Arnett, Shane Chestnutt

In this study a method to route autonomous aerial vehicles away from populated regions using road network data is described. An autonomous, small-scale quadrotor with an onboard GPS is used to demonstrate the routing process.

■ WD09

Level 2 - Room 200I

Inventory Management in Retail Operations

Contributed Session

Chair: Stefan Minner, Technische Universität München, Arcisstrafle 21, Munich, Germany, stefan.minner@tum.de

1 - Joint Inventory and Pricing Decision with Trade Credit

Weili Xue, Southeast University, Nanjing, Nanjing, China, wlxue1981@gmail.com, Frank (Youhua) Chen, Lijun Ma

This talk considers the retailer's inventory and selling price decisions when trade credit is offered in a finite planning horizon. The optimal policy is provided. Specifically, when there is no on-hand inventory, a base-stock listed price policy is optimal; otherwise, a state-dependent order-up-to level with listed price policy is optimal. Monotone properties of the optimal decisions are derived. Extensions are discussed. Numerical studies are conducted to derive further managerial insights.

2 - Determining Order Packaging Quantities in Grocery Retailing

Michael Sternbeck, Catholic University of Eichstaett-Ingolstadt, Auf der Schanz 49, Ingolstadt, 85049, Germany, michael.sternbeck@ku.de

We consider the problem of sizing order packaging quantities (OPQs) in grocery retailing from an instore perspective. This is the number of consumer units that are combined to one order and distribution unit for supplying the individual stores. The OPQ is identified as one driver of instore efficiency. We present an instore operations cost model based on a replenishment cycle system that is used by retailers. The results indicate that integrating instore handling is of major importance.

3 - Dynamic Inventory Management with Cash Flow Constraint and Advance Demand Information

Ye Shi, University of Science & Technology of China, No. 96, Jinzhai Road, Hefei, 230026, China, hecralies@gmail.com, Sean Zhou, Yugang Yu

We consider a finite horizon, periodic review inventory system which incorporates Advance Demand Information (ADI) and cash flow constraints. We show that a state dependent base stock policy is optimal, of which the base stock level is not monotonic in ADI generally. We further identify the conditions that lead to monotonicity property. We also examine how the value of ADI is affected by cash flow constraints.

4 - Resource Allocation of Non-Profits: A Case of Animal Shelters

Nazli Turken, University of Florida, 2220 SW 34th St., Apt. 147, Gainesville, FL, 32608, United States of America, nazliturken@ufl.edu

In this paper, we are trying to analyze the rehoming/adoption process at the animal shelters using queuing theory and optimization approach. Given the arrival and adoption rate of the animal shelters we calculate performance measures such as the average waiting time, rejection and euthanization rate and utilization of the shelters. Finally, we identify the optimal resource allocation strategy that minimizes the performance metrics.

■ WD11

Level 2 - Room 201A

Sports and Entertainment

Contributed Session

Chair: Andriy Shapoval, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, ashapoval3@gatech.edu

1 - Routing and Scheduling Baseball Scouts

Ahmet Ozlu, Georgia Institute of Technology, 2044 Defoors Xing NW, Atlanta, GA, 30318, United States of America, a.o.ozlu@gmail.com, Joel Sokol

A baseball team needs to schedule which scouts should see each of thousands of games over six months, subject to business constraints on travel, baseball-related needs, time off, etc., while minimizing the overall transportation and lodging costs. In this study, theoretical and computational features of this large-scale network-based integer program are explored to give insight into strategic tradeoffs between cost, value of information gained, and worker satisfaction.

2 - Managing Guest Flow in Georgia Aquarium after the Dolphin Tales Opening

Andriy Shapoval, Georgia Institute of Technology, 765 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, ashapoval3@gatech.edu, Eva Lee

Georgia Aquarium recently opened a new exhibit-show named Dolphin Tales. Before the opening, the Georgia Tech team was invited to study and predict how the new exhibit would impact the guest flows and how to optimize the operations logistics. The Aquarium had new events after that opening, and this study is dedicated to the guest flows to the scheduled shows in new circumstances. We provide and solve a large scale MINP problem for minimization labor resources to prevent and control congestions.

3 - Multiple Criteria Sports Scheduling: Minimizing Carry-over Effects and Breaks

Athena Alimirzaei, PhD Condidate, Southern Methodist University, 3850 West Northwest HWY, 3407, Dallas, TX, 75220, United States of America, aalimirzae@smu.edu

The business of professional team sports is so big that the concept of fair schedules is of great interest. Mathematical optimization can be very useful in the creation of fair schedules. The best round robin schedule is one that takes into account both the carry-over effects and the minimum number of breaks. The objective of this investigation is to develop procedures that assist a decision-maker choose the best tournament while taking into account both carry-over effects and total breaks.

■ WD12

Level 2 - Room 201B

Empirical Finance

Contributed Session

Chair: Yeliz Ekinci, Dogus University, Kadikoy, Istanbul, Turkey, ekinciyeliz@yahoo.com

1 - Stock Market Margin Requirements and the 2008 Financial Crisis

Laurent Pauwels, Assistant Professor, University of Sydney, Merewether Bldg. H04, Butlin Ave., Room 489, Sydney, 2006, Australia, laurent.pauwels@sydney.edu.au, Dmytro Matsypura

This paper hypothesises that the change in margin requirements for margin loans from 2005 until 2007 led to a speculative bubble in margin debt across U.S. stock market. The presence of a bubble is tested with recursive methodology that relies on modifications of unit-root and structural change tests commonly used in empirical finance. The tests also identify the start and end dates of the bubble. There is evidence of a bubble in margin debt starting in August 2006 and ending in September 2008.

2 - Study on Contract Model for Venture Capital Based on Overconfidence and Supervision

Zha Bo, PhD, School of Management, Xi'an Jiao Tong University, P.O.Box1851 Xiëan Jiao tong University, Xi'an, 710049, China, zhabo127127@163.com, guo ju-e

Combining entrepreneurs' overconfidence with venture capitalists' supervision, we establish principal-agent relationships among venture capitalist, bank and entrepreneur, prove that there exist the critical value of venture capitalists' supervision, then we analyze the impact of overconfidence and supervision on the relationships among venture capitalist, bank and entrepreneur.

■ WD13

Level 2 - Room 202A

Intelligent Agents and Systems

Contributed Session

Chair: Xiao Chen, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, chen2847@umn.edu

1 - Modeling Information Leakage - An Agent based Approach

Vivek Vasudeva, Student, McCombs School of Business, Austin, TX, 1 University Station, B6000, Austin, TX, 78712, United States of America, vivek.vasudeva@phd.mccombs.utexas.edu

We use agent based simulation to study information leakage in a supply chain comprised of suppliers and retailers. The retailers differ in terms of the reliability of their forecasts; the suppliers in their propensity to leak the retailers' order information. The interactions are modeled as a repeated prisoners' dilemma game and conditions are found under which information leakage could be minimized.

2 - Online Matching with Concave Returns under Random Permutation Model

Xiao Chen, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, chen2847@umn.edu, Zizhuo Wang

An extended Adwords problem considers the allocation of a sequence of keyword searches arriving online to a set of agents with concave returns. The objective is to maximize the total returns from each agent. We propose a dynamic learning algorithm that repeatedly uses the dual information from the observed data to make future allocations. We show that our algorithm achieves near optimal performance under some mild conditions when searches arrive in a random order.

■ WD14

Level 2 - Room 202B

Manufacturing and Operations Management in Supply Chain

Contributed Session

Chair: Susan Laird, George Washington University, 12679 Cheyenne CT, Lusby, MD, 20657, United States of America, selaird@gwu.edu

1 - Expected Value of Uncertainty Reduction: An Entropy Based Analysis of the Newsvendor Problem

Adam Fleischhacker, University of Delaware, 222 Alfred Lerner Hall, Newark, DE, 19716, United States of America, ajf@udel.edu, Pak-Wing Fok

We develop an entropy-based methodology to calculate the expected value of a newsvendor's demand uncertainty reduction effort. The methodology requires neither observations of sampled demand or a priori assumptions regarding potential uncertainty reduction outcomes. Rather, entropy-based techniques enable the assignment of probability distributions to model both present and future states of uncertainty. These assignments are shown to be both intuitively satisfying and theoretically justified.

2 - Rethinking the Value of Demand Learning in a Supply Chain with Censored Demand

Yunru Han, PhD, Columbia Business School, 150 Claremont Ave., Apt.6C3, New York, NY, 10027, United States of America, yhan14@gsb.columbia.edu, Fangruo Chen

We study demand censorship problem in a supply chain of one supplier and one retailer. In a two-period game, the supplier sets the wholesale price as a Stackelberg leader in response to the retailer's inventory policies. We show the "myopic" retailer and the supply chain could be better compared to the case with observed demand, and the "learning" retailer could be worse compared to the "myopic" one. The retailer may even intentionally create demand censorship without the supplier's commitment.

3 - Managing the Unreliable Buyer

Wenli Peng, Research Assistant, Université Catholique de Louvain, CORE - Voie du Roman Pays 34 bte L1.03.0, Rue Haute 72/302, Louvain-la-Neuve, Belgium, wenli.peng@uclouvain.be, Philippe Chevalier

This paper capatures the characteristics of unreliable buyers. We study the effect of demand variability on the working capital requirement and the optimal scheduling. The objective of this paper is to provide some insight into how to manage the buyers with different levels of demand variability.

4 - Crowdsourcing Supply Chain Resource Allocation – A Systems Approach

Susan Laird, George Washington University, 12679 Cheyenne CT, Lusby, MD, 20657, United States of America, selaird@gwu.edu, Thomas Holzer, Shahryar Sarkani, Timothy Eveleigh

Costs to maintain remote systems have grown past 60% of total ownership cost yet end system availability is unacceptably low (at times by 30% of minimum) despite supply chain reengineering. Resource allocation methods often rely on localized expertise that results in sub-optimization of the entire system. This presentation will discuss doctoral research on the influence of subject matter expertise using a competitively crowd sourced game as a human computation method for resource allocation.

■ WD15

Level 2 - Room 203

Service Science Applications in Healthcare Operations

Sponsor: Service Science

Sponsored Session

Chair: Sanjeev Bordoloi, Associate Professor, University of St., Thomas, Opus College of Business, 1000 LaSalle Ave., TMH 443, Minneapolis, MP, 55403, United States of America, bord9806@stthomas.edu

1 - Use of Lean 3P Tools to Optimally Expand Clinical Space at TRIA Orthopaedic Center

Sunny Ray, Director, Quality Improvement, TRIA Orthopaedic Center, 8100 Northland Drive, Bloomington, MN, 55431, United States of America, Sunny.Ray@TRIA.com

TRIA Orthopaedic Center (Bloomington, MN) has grown in clinic volumes 234% since opening in 2005, and space constraints were a barrier to continued growth, patient access and physician recruitment. Lean 3P (production preparation process) tools were used to understand the needs of space expansion requirements, and design and sequence expansion.

2 - Ideas to Action: Application of Quality Tools in Outpatient Healthcare

Linda Laganga, Director of Quality Systems & Operational Excellence, Mental Health Center of Denver, 4141 East Dickenson Place, Denver, CO, 80222, United States of America, linda.laganga@mhcd.org, Cathie McLean, Paul Frankel, Craig Iverson, Jim Linderman, CJ McKinney, Wes Williams

We apply Tools of Quality to engage work teams in problem identification and solution implementation. We present recent projects, measurable results, and quantifiable value to the organization. Our Pareto analysis and utilization management tools identify costly service patterns and guide redistribution of resources to improve consumer outcomes and cost-effectiveness.

3 - Operating Room Planning with Multiple Surgical Types

Narges Hosseini, Mayo Clinic, 200 1st St., SW, Rochester, MN, 55905, United States of America, hosseini.narges@mayo.edu, Thomas Rohleder, Yariv Marmor, Jeanne Huddleston

Planning capacity for surgeries can be challenging with multiple types of surgeries using the same set of resources. Different categories of surgeries due to clinical factors, urgency, and payer type affect the operational and financial performance of a suite of operating rooms. In this study, based on the Urology Department at Mayo Clinic, we consider the allocation of OR capacity and sequencing of surgeries to maximize patient access while meeting staff satisfaction and financial constraints.

4 - Exploring Impact of Management of Chronic Illnesses through Prevention on U.S. Healthcare System

Sameer Kumar, Professor, University of St., Thomas, Opus College of Business, 1000 LaSalle Ave., Minneapolis, MN, 55403, United States of America, sameerkumar724@gmail.com

Explores how dynamical growth of chronic diseases contributes to increasing chronic treatment costs, negatively affecting available funds for preventive measures and subsequently affecting the growth of health risk factors. Treatment of chronic diseases presents a major cost burden to the U.S. National Healthcare. Without aggressive intervention into root causes of these chronic diseases and their costs, these trends are expected to worsen.

■ WD16

Level 2 - Room 204

Incentives in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Hui Zhang, PhD Student, Virginia Tech, 236 Durham Hall, Virginia Tech, Blacksburg, VA, 24060, United States of America, corinnaz@vt.edu

Co-Chair: Christian Wernz, Assistant Professor, Industrial and Systems Engineering (ISE), Virginia Tech (VT), Blacksburg, VA

1 - A Market Design Approach to the Adoption of Children in Pennsylvania

Mustafa Akan, Assistant Professor of Operations Management, Carnegie Mellon University, United States of America, akan@andrew.cmu.edu, Onur Kesten, Utku Unver

Adoption is an important phenomenon in the U.S. Notwithstanding the growing demand and prominence of the issue, little is known about what assignment protocol needs to be employed by agencies. Inspired by our ongoing collaboration with Pennsylvania's Statewide Adoption Network, we study the incentives in child adoption through the lens of operations and economics, and make recommendations for alternative systems that can ameliorate the deficiencies of current assignment plans.

2 - Aligning Incentives in the Multi-level Health Care System

Hui Zhang, PhD Student, Virginia Tech, 236 Durham Hall, Virginia Tech, Blacksburg, VA, 24060, United States of America, corinnaz@vt.edu, Christian Wernz

Current incentive structures in the U.S. health care system contribute to the overuse of diagnostic technologies, such as Computed Tomography. Using multiscale decision theory, we analyze the interaction between health care stakeholders across multiple levels. We identify incentive mechanism given multiscale interdependencies that can align stakeholders' actions. Our findings can inform incentive alignment for Accountable Care Organizations and the Medicare Shared Savings Program.

■ WD17

Level 2 - Room 205A

Scheduling

Sponsor: Service Science

Sponsored Session

Chair: Guiping Hu, Iowa State University, 3014 Black Engineering, Ames, IA, 50011, United States of America, gphu@iastate.edu

1 - Sequential Clinical Scheduling with Patient Re-entrant: The Case of Skin Cancer Surgery

Haolin Feng, Lingnan College, Sun Yat-sen University, Guangzhou, China, FengHaoL@mail.sysu.edu.cn, Stephen Steidle, Seokcheon Lee, Mark Lawley

Mohs Micrographic Surgery is a popular skin cancers excision method yielding low recurrence rate and positive cosmetic results. It repetitively removes one skin layer at a time until a cancer free layer is found, and this brings same-day patient re-entrants. Currently patients often experience long in-clinic waiting due to the stochastic nature of layer removals. We develop a sequential scheduling scheme to improve patient experience and clinic revenues. Numerical study shows great improvements.

2 - Robust Project Scheduling at a Large IT Services Delivery Organization

Elvin Coban, Ozyegin University, Department of Industrial Engineering, Istanbul, Turkey, elvin.coban@ozyegin.edu.tr, John Hooker, Aliza R. Heching, Alan Scheller-Wolf

We consider a practical project scheduling problem at a large IT services delivery organization with cross-trained employees, heterogeneous projects, schedule disruptions, and service quality guarantees. Durations of subtasks, disruptions, and project arrival times are uncertain. Our goal is to identify an effective scheduling of project subtasks and assignments to each employee. We capture uncertainties in a robust scheduling model by uncertainty sets using logic-based Benders decomposition.

3 - Production Scheduling for Fast Pyrolysis Fractionation with Lot-sizing

Qi Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50011, United States of America, qili@iastate.edu, Guiping Hu

Fast pyrolysis fractionation is a prominent technology for cellulosic biofuel production. In the process, a series of condensers and ESPs are used to recover bio-oil into fractions. The fractions could go through different upgrading processes. In this study, a production scheduling problem considering the trade-off between proportional production costs, set-up costs, and inventory costs is studied. Mixed integer linear programming model with lot-sizing is formulated and case study is presented.

■ WD18

Level 2 - Room 205B

Dynamic Programming Methods and Applications

Contributed Session

Chair: Abhijit Gosavi, Missouri University of Science and Technology, 219 Engineering Management Bldg, Missouri S&T, Rolla, MO, 65401, United States of America, gosavia@mst.edu

1 - Dynamic Programming Based Inequalities for the 0-1 Knapsack Problem

Kun Zhao, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, zhaokunzk@ufl.edu, Joseph Hartman

Forward dynamic programming for the 0-1 knapsack problem is used to generate inequalities for an equivalent integer programming formulation. Upper bounds are generated using information of intermediate-stage sub-optimal solutions. Cover inequalities traditionally used in separation algorithms can also be defined through intermediate stages of the dynamic programming recursion. We illustrate the effectiveness of the approach through experimental testing.

2 - Valid Inequalities for the 0-1 Knapsack Formulations through Dynamic Programming

Emmanuel des-Bordes, Graduate Research Assistant, Wichita State University, 1845 Fairmount Street, Wichita, KS, 67260, United States of America, exdes-bordes@wichita.edu, Esra Buyuktahtakin

We present studies on three forms of valid inequalities for solving the 0-1 knapsack problem using recursive solutions of the corresponding dynamic programming formulation. These valid inequalities can be lifted into stronger inequalities, which are shown to improve the solution time of the 0-1 knapsack instances.

3 - Optimal Control Strategies for Trajectory Optimization with Applications to Perpetual Solar Flight

Ashwin Balakrishna, Cupertino High, 10100 Finch Ave., Cupertino, CA, 95014, United States of America, abalakrishna@gmail.com

This work focuses on developing methods to solve the dynamic models common in flight trajectory optimization using finite element discretization. Detailed results will be presented for optimization of solar powered flight, by finding the optimum climb-descent profile, while minimizing the required on-board battery mass. Control profiles include the lift coefficient, thrust, battery charge and discharge rates which are optimized based on the latitude and day of year at launch.

4 - A New Value Iteration Technique for Solving Average Reward SMDPs

Abhijit Gosavi, Missouri University of Science and Technology, 219 Engineering Management Bldg, Missouri S&T, Rolla, MO, 65401, United States of America, gosavia@mst.edu, Shuva Ghosh, Susan Murray

Average reward (or cost) semi-Markov decision processes (SMDPs) arise in many real-world problems, including preventive maintenance (PM), for which policy iteration is an accepted technique. Bertsekas (2000) has established a connection between Markov control and the stochastic shortest path (SSP). Exploiting this connection, we develop a new value iteration algorithm for solving average reward SMDPs. We test our algorithm numerically on a PM problem and study its convergence properties.

■ WD19

Level 2 - Room 205C

Stochastic Networks: Approximations and Control

Sponsor: Applied Probability

Sponsored Session

Chair: Xin Liu, University of Minnesota, 207 Church Street SE, 306 Lind Hall, Minneapolis, MN, United States of America, liuxin@ima.umn.edu

1 - Equivalence of Two-parameter and Measure-valued Fluid Models for G_t/GI/N+GI Queues

Weining Kang, University of Maryland, Baltimore County, 1000 Hilltop Circle, Baltimore, MD, 21250, United States of America, wkang@umbc.edu, Guodong Pang

In this talk, we show the equivalence of two fluid models for G_t/GI/N+GI queues, the two-parameter fluid model by Whitt (2006) and the measure-valued fluid model by Kang and Ranaman (2010). We also explore connections between fluid models tracking residual times and fluid models tracking elapsed times.

2 - Non-Markovian State-dependent Networks in Critical Loading

Chihoon Lee, Colorado State University, 221 Statistics Building (CB#1877), Fort Collins, CO, 80523-1877, United States of America, chihoon@stat.colostate.edu, Anatolii Puhalskii

We establish heavy traffic limit theorems for queue-length processes in critically loaded single class queueing networks with state-dependent arrival and service rates. A distinguishing feature of our model is non-Markovian state dependence. The limit stochastic process is a continuous-path reflected process on the nonnegative orthant. We give an application to generalized Jackson networks with state-dependent rates.

3 - Optimal Rate for a Queueing System in Heavy Traffic with Superimposed On-Off Arrivals

Arka Ghosh, Iowa State University, 3216 Snedecor Hall, Ames, IA, 50014, United States of America, apghosh@iastate.edu

We consider a queueing control problem with a system with heavy-tailed On-Off process arrivals and constant-rate service.The control problem is to find the optimal value of the service rate which minimizes an infinite horizon discounted cost. The main result of the paper guarantees the existence of an optimal rate and specifies an explicit range of possible values of this optimal rate. We also derive and use an asymp. maximal bound on the second moment of the centered cumulative On-Off process.

4 - Diffusion Model for a Double-ended Queue with Renewal Arrival Processes

Xin Liu, University of Minnesota, 207 Church Street SE, 306 Lind Hall, Minneapolis, MN, United States of America, liuxin@ima.umn.edu, Qi Gong, Vidyadhar Kulkarni

We study a double-ended queue where buyers and sellers arrive to conduct trades. When there is a pair of buyer and seller in the system, they immediately transact a trade and leave. We assume renewal arrivals and exponential impatience time for both buyers and sellers. A diffusion approximation is established in a heavy traffic regime, and the invariant measure of the limiting diffusion process, which is an asymmetric O-U process, is studied.

■ WD20

Level 2 - Room 205D

Pricing and Revenue Management in Transportation and Social Networking

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ban Kawas, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, bkawas@us.ibm.com

1 - Optimal Fare Differentiation in Airline Industry with Demand Leakages

Syed Asif Raza, Assistant Professor, Qatar University, College of Business and Economics, Doha, 2713, Qatar, syedar@qu.edu.qa

This research addresses the issue of establishing an integrated framework to optimize the fare pricing, and seat inventory control for an airline that experiences the demand leakage in its fare classes. Models are proposed for an airline that experiences deterministic demand, stochastic demand, and stochastic demand whose distribution is unknown. These models are analyzed to outline an integrated optimal control framework for fare pricing, seat inventory control decisions for an airline.

2 - A Win-win Pricing Strategy in Social Networking Advertising
Yingying Kang, Senior Operations Research Consultant, JDA Software Group Inc., 3200 Windy Hill Road, Suite 1550, Atlanta, GA, 30339, United States of America, eing.008@gmail.com

Social network has become a powerful medium for business to achieve their marketing goals. How to balance the benefits between both advertisers and social networking sites, is a key point to gain maximum revenue but at the same time gaining the long-term relationship with advertisers. This achieves a "win-win" marketing strategy. This model maximizes their total revenue by setting various advertisement prices, while balancing the benefits of individual advertisers.

3 - Revenue Management in Public Transportation
Ban Kawas, IBM T.J. Watson Research Center, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, bkawas@us.ibm.com, Olivier Gallay

Public transportation demand forecasting is an integral part in setting the base price of travel tickets. In practice, it is a complex task as it involves a deep understanding of customers' travel behaviour and their sensitivity to tickets' prices. We propose an approach that tackles this challenge when managing revenues for a public transport operator. We derive a quadratic program that maximizes total revenues and explicitly addresses demand uncertainty. Numerical results are encouraging.

■ WD21

Level 2 - Room 206

Health Care VI: Monitoring and Prevention

Contributed Session

Chair: Dayna Martinez, Post-doctoral Research Associate, Northeastern University, 360 Huntington Ave., 334 Snell, Boston, MA, 02115, United States of America, d.martinez@neu.edu

1 - Monitoring Health Risks and Predicting Healthcare Utilization, from Actuarial Perspective
Liang Zhou, Statistician, SavvySherpa, 6200 Shingle Creek Pkwy, Ste. 400, Minneapolis, MN, 55430, United States of America, lzhou@savvysherpa.com

US government and health insurance companies strive to provide high quality care while reducing the overall costs. It is thus important to manage the risks of the insured through better monitoring and predicting healthcare utilization. Healthcare actuaries often work with medical transaction data, which contains diagnosis, procedure and financial information. This talk covers an introduction of medical transaction data, predicting utilization and monitoring risk pool using transaction data.

2 - Implementing a Patient-Centered Surgical Home to Improve Outpatient Surgery Processes
Dongyang Ester Wang, University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, 78712, United States of America, wdy@utexas.edu, Douglas Morrice, Susan Noorily, Jonathan Bard, Luci Leykum, Poornachand Veerapaneni

The outpatient surgery process is information intensive, but a patient's medical record is often fragmented. As a result, preoperative screening is frequently prolonged by missing information which can lead to surgery delay or cancellation. In this study, we simulate an outpatient surgery to quantify the impact of patient information deficiency and to assist in the development of a patient-centered surgical home to mitigate this problem through better system-wide coordination.

3 - Using a Closed Queueing Network to Analyze Resource Allocation for Emergent Patient Flow
Afrifah Bobbie, Student, University of Central Florida, 4000 Central Florida Boulevard, Orlando, Fl, 32816, United States of America, afrifah@knights.ucf.edu

A nationwide reduction of 27 percent of emergency departments has stalled current patient flow. Admitting patients to hospital units significantly delays other patients from seeing a physician. We present a resource allocation tool that employs a novel closed queueing network method to analyze ED patient flow. The model considers ED-hospital interaction and contributes blocking to a closed queueing network.

4 - Reducing Central Line Bloodstream Infections in Intensive Care Units
Dayna Martinez, Post-doctoral Research Associate, Northeastern University, 360 Huntington Ave., 334 Snell, Boston, MA, 02115, United States of America, d.martinez@neu.edu

Central Line-Associated Bloodstream Infections (CLABSI) are one of the most deadly and costly hospital-associated infections according to the Institute for Healthcare Improvement. CLABSI has been shown to be preventable through various interventions. We present our systems engineering approach to prevent, identify and mitigate these infections.

■ WD22

Level 2 - Room 207

Health Care V: Quantitative Approaches in Modeling

Contributed Session

Chair: David Phillips, Asst. Professor, U.S. Naval Academy, Mathematics Department, Annapolis, MD, 21403, United States of America, dphillip@usna.edu

1 - Comparing Alternative Workflow Modes of Mid-Level Care Providers
Denise White, Cincinnati Children's Hospital Medical Center, 3333 Burnet Avenue, MLC 5040, Cincinnati, OH, United States of America, DeniseL.White@cchmc.org, Craig Froehle, Elham Torabi

A mid-level provider (MLP) is typically integrated into outpatient clinic workflow either seeing patients before the physician or by seeing some patients as their stand-alone provider. Through queuing formulation and simulation, we compare these approaches to identify the optimal deployment policies when considering both operational and financial objectives.

2 - Modeling and Analysis of PCA Workflow at an Inpatient Care Unit
Ewing Tiong, Western Michigan University, 4601 Campus Dr., Kalamazoo, MI, 49008-5336, United States of America, ewing.s.tiong@wmich.edu, Laila Cure

Healthcare environments exhibit high variability in their processes, thus the work of healthcare providers is highly variable from day to day. Most operations research applications related to nursing work focus on medium to long term decision epochs, but very few focus on daily workflow. We focus on the workflow of patient care assistants in an inpatient unit and propose a decision support model to identify efficient strategies to provide care to patients, given the available resources.

3 - Optimal Design for fMRI
Moein Saleh, Student, Arizona State University, 699 S. Mill Ave., Mail code:8809, Tempe, AZ, 85281, United States of America, moein.saleh@asu.edu, Ming-hung Kao, Petek Yontay

Functional Magnetic Resonance Imaging (fMRI) is a brain mapping technique widely used in research fields such as cognitive neuroscience, medical science, psychology, and education for studying functions of the brain. Popularity of fMRI on one hand and the high cost of fMRI experiments on the other hand motivate the scientists to design informative experiments. In this presentation; we propose a new Coordinate Exchange Algorithm to find the optimal design for fMRI problem.

4 - Analyzing and Assessing Brain Functioning with Invariant Graph Connectivity Measures
David Phillips, Asst. Professor, U.S. Naval Academy, Mathematics Department, Annapolis, MD, 21403, United States of America, dphillip@usna.edu, Leah Jager, Anja Soldan, Alec McGlaughlin

We use graph invariants to analyze the structural brain-connectivity in patients with dementia versus healthy adults. Particular challenges include determining the underlying network, and assessing the validity of the graph invariant used. We present an optimization-model method to determine model validity as well as several potential graph invariants of interest. Computational results are presented applying the methods to magnetic resonance imaging data.

■ WD23

Level 2 - Room 208A

Price and Revenue Optimization for Retail Industry

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Natalia Viktorovna, SAS Institute, SAS Campus Drive, Cary, 27513, United States of America, Natalia.Viktorovna@sas.com

1 - Product Line Pricing Analysis in the Retail Industry Context
Shaligram Pokharel, Associate Professor, Qatar University, PO Box 2713, Doha, Qatar, shaligram@qu.edu.qa, Mohamed Kharbeche, Bacel Maddah, Ahmed Ghoniem

Product line pricing is important for retailers to create purchaser's perception on value of goods. A good pricing would help the retailer in managing supply chain policies. In this presentation, models for the product line pricing for a large scale retail industry are proposed by incorporating price elasticity and the utility function coefficients in order to come up with various pricing decision options. Computational results and an empirical analysis are reported for these exact models.

2 - Dynamic Pricing and Inventory Decisions for Perishable Products
Onur Kaya, Asst. Professor, Koç University, Koç University, Eng 206, Sariyer, Istanbul, 34450, Turkey, okaya@ku.edu.tr, Sajjad Rahimi Ghahroodi

We focus on the pricing and inventory decisions for perishable products in a stochastic setting in which the demand is affected with the prices and the freshness of the products. We model this problem through a dynamic programming formulation and determine the optimal inventory and pricing decisions. We prove certain characteristics of the optimal solution and also analyze the effect of different parameters through numerical experiments. This work is supported by Tubitak grant #111M533.

3 - Multicriteria Model for Price/Promotion Optimization
Natalia Viktorovna, SAS Institute, SAS Campus Drive, Cary, 27513, United States of America, Natalia.Viktorovna@sas.com, Maarten Oosten

Marketing efforts are commonly used to drive customer demand. This research focuses on modeling the pricing as well as the selection and allocation of promotions, specifically those in retail industry (coupons, circulars, etc.) with a novel multicriteria approach. A known algorithm as NSGA-II is then used to solve the mathematical formulation.

■ WD24

Level 2 - Room 208B

Online Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ram Bala, Santa Clara University, 500 El Camino Real, Santa Clara, CA, United States of America, rbala@scu.edu

1 - Cost-per-Impression Pricing for Display Advertising
Sami Najafi-Asadolahi, University of Toronto, Toronto, ON, Canada, sami.najafi@rotman.utoronto.ca, Kristin Fridgeirsdottir

We determine the optimal cost-per-impression (CPM) prices of display ads for a web publisher facing uncertain demand from advertisers requesting space on its website and uncertain supply of impressions from viewers. We formulate the problem as a novel queueing system, where the advertising slots correspond to service channels providing synchronized services. We discuss the model and show that, e.g., the optimal CPM price may increase in the number of ads rotating among slots.

2 - Google Search and Cross-channel Competition
Tawei Wang, University of Hawaii at Manoa, 2404 Maile Way, BUSAD E602C, Honolulu, HI, 96822, United States of America, twwang@hawaii.edu, Wenqi Shen, Roger Debreceny

This study investigates whether online information seeking behaviors (captured by Google search volume) is associated with retailers' online sales revenues and how such online attention affects the sales revenues through the traditional channel. The main findings suggest that Google search volume can be used as a proxy for the general attention or interests towards a firm which in turn leads to opposite impact on sales revenues through online versus the traditional channel.

3 - Sponsored Search vs. Search Engine Optimization: Competitive Strategies for Internet Retailers
Ram Bala, Santa Clara University, 500 El Camino Real, Santa Clara, CA, United States of America, rbala@scu.edu, Amit Mehra, Jagmohan Raju

We formulate a game-theoretic model of competition between a small Internet retailer and a branded retailer such as Amazon, where customer traffic is directed to the retailers through organic or sponsored links at search engines. Thus, retailers can invest in search engine optimization (SEO) to improve customer traffic through organic links, or invest in keyword bidding to get this traffic through sponsored links. We uncover several insights regarding the mix of investments in these two options.

4 - "Showrooming" and the Competition between Store and Online Retailers
Amit Mehra, Assistant Professor and ISB Research Fellow, Indian School of Business, Hyderabad, India, Amit_Mehra@isb.edu

Showrooming is free riding by customers who evaluate products at brick-and-mortar stores to pick their best fit product, but buy this product at a competing online retailer if that product is available at a lower price. We evaluate several strategies to contain the loss of profit for brick-and-mortar stores due to this customer behavior.

■ WD26

Level 2 - Room 208D

Facility Planning II

Contributed Session

Chair: Celestine Aguwa, Visiting Assistant Professor, Wayne State UNiversity, 4815 Fourth Street, Detroit, MI, 48201, United States of America, celestine.aguwa@wayne.edu

1 - Multi-objective Optimization Model and Algorithm Considering Carbon-Capped Difference in the CLRIP
Shoufeng Ji, Professor, Northeastern Unversity, No 11 Lane 3 Wenhua Rd., Heping District, Liaoning, Shenyang, 110819, China, sfji@mail.neu.edu.cn, Haifei Yu

Carbon-capped is defined in the paper, which is used to construct the multi-objective nonlinear integer programming model which consist of economic cost and carbon emissions, we should optimize the two objectives; we design a multi-objective particle swarm optimization(MOPSO) algorithm by equivalence processing in the objective function.

2 - Layout Planning Algorithms with Congestion Considerations
Fatih Mutlu, Assistant Professor, Qatar University, MIE Department, Doha, 2713, Qatar, fatihmutlu@qu.edu.qa

The traditional layout planning algorithms aim at minimizing the total flow. However, the resulting solutions may generate congestion along some of the paths, which is typically not considered in the optimization model. In this research, we develop an efficient layout planning algorithm which tries to optimize the flow and congestion simultaneously. We compare the performance of traditional layout algorithms to ours in terms of total flow and traffic congestion.

3 - Multistage Facility Location Problem under Uncertainty
Nalan Gulpinar, Associate Professor, Warwick Business School, The University of Warwick, Coventry, CV4 7AL, United Kingdom, nalan.gulpinar@wbs.ac.uk

This paper considers multistage facility location problem in which multiple facilities serve customers with a single product. Customer demand is assumed to be uncertain. We study robust approximations to the problem in order to incorporate information about the random demand distribution in the best possible, computationally tractable way. Finally, we present numerical experiments that illustrate the performance of the different robust formulations.

4 - A Multiple-product Multiple-server System-choice Congested Facility Location Problem
Hossein Abdollahnejadbarough, Northern Illinois University, 590 Garden Road, EB230, dekalb, IL, 60115, United States of America, hossein.abdolahnejad@gmail.com, Sukgon Kim

Non-linear clearing functions which were replaced with the capacity constraints are partitioned and assigned to each product or customer. This portion of the capacity is a decision variable that will be decided with the other decision variables such as the location of the facilities, allocation of demands, number of servers and the congestion of each facility by the optimization model. The outer linearization technique has been applied to resolve the non-linearity of the capacity constraints.

5 - Facilities Design Problem for Satellite Location and Optimization Configuration in Healthcare Systems
Celestine Aguwa, Visiting Assistant Professor, Wayne State University, 4815 Fourth Street, Detroit, MI, 48201, United States of America, celestine.aguwa@wayne.edu, Leslie Monplaisir

To address new site location problem, an adaptive fuzzy-based facilities design problem (FFDP) is developed. The phases address the parameters analysis, and asset optimization respectively. It includes network based location problem which considers the access of the new site(s) to the relevant service sectors. Next is the modularization of FFDP for easy addition of future modules such as knowledge based database. The implications are minimized operating cost and maximized patients' coverage.

■ WD27

Level 2 - Room 209A

Inventory Management: Performance Optimization

Contributed Session

Chair: Chun-Miin Chen, Penn State University, University Park, University Park, PA, 16802, United States of America, cxc732@psu.edu

1 - Inventory Positioning for Performance-based Contracting under Uncertainties

Huayi Jing, Student, NUS, NUS, E1-07-26, Computing Lab, Singapore, 119260, Singapore, a0075569@nus.edu.sg, Kwong Meng Teo

We consider a multi-echelon multi-indenture inventory system, where each location has multiple requirements on different performances. We present two approaches that can help a supplier decide how to position inventories within a multi-echelon multi-indenture network, so that a PBC covering multiple commonly used performance measures can be met at a certain confidence level under uncertainties. Recommendations suggest that both approaches are useful to support large-scale inventory PBCs.

2 - Coordinating a Supply Chain via Discounts

Ginger Ke, Assistant Professor, Memorial University of Newfoundland, Faculty of Business, St. John's, NL, A1B 3X5, Canada, gke@mun.ca, James Bookbinder

Although quantity discounts have been broadly examined, its analysis and coordination with the transportation discount is still in its infancy. Here we develop an approach to coordinate supplier's and carrier's decisions on discount policies under price-elastic demand. We show that this price-sensitivity is a key motivation for supplier and carrier to offer discounts and propose an algorithm to assist the two parties in deciding their discount schemes with consideration of buyer's best response.

3 - Effect of Modeling Fixed Cost in a Serial Inventory System with Periodic Review

Ayse Gönül Karaarslan, Assistant professor, Erasmus University Rotterdam, Burgemeester Oudlaan 50, Rotterdam, Netherlands, a.g.karaarslan@gmail.com, A. G. De Kok, Gudrun Kiesmuller

We study a two-echelon serial inventory system with stochastic demand. We assume that fixed costs are charged only when an order initiates a shipment. Ordering decisions are based on echelon base stock policies. We derive analytical expressions for optimal base stock levels and review periods. In literature, fixed costs are usually charged at every review moment, even if no shipment results due to zero upstream stock. We test the impact of this simplifying assumption in a numerical study.

4 - Continuous-Review (r, nQ) Policies for an Inventory System with Dual Delivery Modes

Chaolin Yang, Chinese University of Hong Kong, Systems Engineering & Engineering Mgmt., 511D, ERB, Shatin, Hong Kong - PRC, clyang@se.cuhk.edu.hk, Sean Zhou

We study a continuous-review inventory system with dual delivery modes. The expedited mode provides a shorter lead time than the regular mode. The ordering cost using each mode consists of both fixed and variable costs. We study a class of simple (r, nQ) type of inventory control policy. We provide an exact procedure to evaluate its performance. Moreover, for a special case: a base-stock policy is adopted for the regular mode, we develop an approach to find the near-optimal policy parameters.

5 - Inventory Allocation Methods and Service Level Agreements

Chun-Miin Chen, Penn State University, University Park, University Park, PA, 16802, United States of America, cxc732@psu.edu, Douglas Thomas

Firms may employ a variety of methods to allocate scarce supply to meet multiple customer demands. We examine the impact to customer service levels of different allocation methods both analytically and computationally. We find substantial differences in customer service performance across different allocation rules.

■ WD29

Level 2 - Room 210A

Effective Teams and Organizations

Contributed Session

Chair: Jonathan Kush, PhD Candidate, Carnegie Mellon University, Tepper School of Business, PhD, 5000 Forbes Avenue, Pittsburgh, PA, 15213-1914, United States of America, jkush@andrew.cmu.edu

1 - Inter-firm Cooperation between Manufacturer and its Supplier in Product Development Projects

Jeong-Eun Shim, KAIST Business School, 85 Hoegiro Dongdaemoon, Seoul, Korea, Republic of, jeshim@kaist.ac.kr, Bowon Kim

Using seven cases of manufacturer-supplier product development, we examine how supplier involvement and inter-firm communication determine the performance of product development projects. After defining relational norm and technological factors such as knowledge distribution and technological uncertainty, we explore how the relational and/or technological factors moderate the relationship between coordination mechanisms and project performance.

2 - Asymmetries in Identifications to Workgroup and Organization

Fang Kong, Xi'an Jiaotong Univeristy, No. 28 Xianning West Road, Xi'an, China, kongfang99@126.com, Peng Liu, Xiping Zhao

Drawing on social projection theory, self-categorization theory and social identity theory, we shed light on the distinctions between workgroup identification and organizational identification from three prominent aspects. First, differing in the cognitive mechanisms and routes; second, differing in underlying motives and base; finally, differing in related outcomes, i.e., job satisfaction and turnover intension.

3 - Transactive Memory, Turnover and Team Performance

Jonathan Kush, PhD Candidate, Carnegie Mellon University, Tepper School of Business, PhD, 5000 Forbes Avenue, Pittsburgh, PA, 15213-1914, United States of America, jkush@andrew.cmu.edu

This research examines whether the effect of turnover on team performance depends on the development of transactive memory systems (TMS). Results indicate that TMS improves team performance. Further, groups that are trained together and have a well-developed TMS improve less after turnover than groups that are trained individually and have a less-developed TMS. This suggests that these groups may benefit more from the introduction of new members than groups with well-developed TMS.

■ WD30

Level 2 - Room 210B

Integer Programming Applications II

Contributed Session

Chair: Herve Kerivin, University Blaise Pascal - Clermont-Ferrand II, Limos - CNRS UMR 6158, Aubiere, France, hkerivin@gmail.com

1 - A Surrogate-RLT Cutting Plane Algorithm for 0-1 Knapsack Problems

Junsang Yuh, Korea University, Sung-buk Gu, Anam-dong 5ga, Seoul, Korea, Republic of, yuhjunsang@gmail.com, Youngho Lee, Gigyoung Park

We present an efficient cutting plane algorithm that gives valid inequalities called surrogate-RLT cuts (SR cuts) for solving 0-1 knapsack problems. We combine the concept of surrogate-knapsack cuts and reformulation-linearization technique (RLT) to generate strong valid inequalities. We also provide numerical examples that describe alternative convex hull representation for the problem derived by SR cuts. Finally, computational results for a set of 0-1 integer programming problems are reported.

2 - Spatial Designing of a Reserve Network Problem

Nahid Jafari, Research Staff, CSIRO, Mathematics, Informatics and Statistics, Clayton, Melbourne, 3181, Australia, nahid.jafariasbagh@rmit.edu.au

In selecting sites for reserve design purposes connectivity of habitat is important for allowing species to move freely within a protected area. A MIP model is formulated for the design of a network of sites which maximizes utility subject to a budget limitation and spatial attributes such as connectivity and compactness. The model has the trade-off between the number of contiguous areas and utility and does not require any assumptions about the regular shape of candidate sites.

3 - Optimizing Nuclear Waste Disposal: Yucca Mountain Case Study
Benjamin Johnson, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, blj.man.up@gmail.com, Jeffrey King, Alexandra Newman

This research determines a methodical way to dispose of nuclear waste within a repository, specifically, Yucca Mountain. The current objective is to minimize heat load; however, other objectives involving dosage or cost could be introduced. Constraints include supply and demand, heat load limitations, and location and time at which waste packages can be placed in the repository. Small scale data will be presented that shows heat load reductions up to 98% compared to other disposal methods.

4 - Efficiency and Productivity of Firms across Indian Cities: A DEA and Stochastic Frontier Analysis
Somesh Mathur, HSS,IITK, Kanpur, India, skmathur@iitk.ac.in

The study will utilize survey and secondary data(CMIE and ASI unit level data base) for sampled firms in different cities of India to understand the impact of host of factors on efficiency and productivity of firms.The study will use DEA and stachstic frontier analysis

5 - Matching-partition Inequalities: New Facets for the Connected Subgraph Polytope
Herve Kerivin, University Blaise Pascal - Clermont-Ferrand II, Limos - CNRS UMR 6158, Aubiere, France, hkerivin@gmail.com, Mohamed Didi Biha, Peh Ng, Jinhua Zhao

Facet-defining inequalities combining the concepts of matching and node partition are introduced for the edge-induced connected subgraph polytope. Their separation problem is studied. Complete characterizations of this polytope are obtained on some classes of graphs. Similar inequalities also appear useful for variants of this polytope, where a root, the acyclic property, and/or bounded-degree requirements are considered.

■ WD31

Level 2 - Room 211A

Financial Econometrics and Statistics

Sponsor: Financial Services

Sponsored Session

Chair: Gustavo Schwenkler, Boston University, 595 Commonwealth Ave., Boston, MA, 02215, United States of America, gschwenk@stanford.edu

1 - Perfect Estimation with Imperfect Samplers
Chang-han Rhee, Stanford University, Stanford University, Stanford, CA, 94305, United States of America, chrhee@stanford.edu, Peter Glynn

We present a randomization idea for constructing unbiased estimators based on a sequence of biased estimators and discuss two applications: computations for stochastic differential equations (SDEs) and Markov chain Monte Carlo. In the first case, the idea produces the first finite-variance unbiased estimators with a "square root convergence rate" for a general class of multi-dimensional SDEs. In the second case, it provides an alternative approach to "perfect sampling" algorithms.

2 - Jumps in Equity Returns before and after the Financial Crisis
Haowen Zhong, Columbia University, Room 350, Mudd Building, New York, United States of America, hz2193@columbia.edu, Steven Kou, Cindy Yu

We find that a simple AJD model fits equity daily return data well; the model outperforms models with Levy jumps during the crisis, and is at least as good before the crisis. Based on the model and the data sets, we conclude that: (i) Jump rates increased significantly during the financial crisis, while there is little evidence that jump sizes have changed. (ii) The empirical evidence favors finite number of large jumps in equity returns.

3 - An Analytic Class of Distributions
Liming Feng, University of Illinois at Urbana-Champaign, 104 S. Mathews Ave., Urbana, IL, 61801, United States of America, fenglm@illinois.edu

It has been established that a probability distribution with a characteristic function in a certain analytic class can be recovered very efficiently. We present conditions under which a characteristic function falls into this analytic class. As a financial example, the distribution of the log return process in the Duffie-Pan-Singleton derivatives pricing model is analyzed.

■ WD32

Level 2 - Room 211B

Networks

Sponsor: Technology Management

Sponsored Session

Chair: Ermin Wei, Massachusetts Institute of Technology, 32-D640 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, erminwei@mit.edu

1 - Network Resilience against Epidemic Spread
Kimon Drakopoulos, Massachusetts Institute of Technology, 32 Vassar Street, 32D-640, Cambridge, MA, 02139, United States of America, kimondr@mit.edu, Asuman Ozdaglar, John N. Tsitsiklis

We study the problem of minimizing the expected extinction time of and epidemic that evolves on a graph according to an SIS model. We consider curing policies for the nodes which exploit the knowledge of the current state of the epidemic. We characterize the family of graphs for which it is possible to achieve subpolynomial extinction time and provide a policy that achieves it. Moreover we prove that for all graphs outside this family the expected extinction time is polynomial.

2 - On the O(1/k) Convergence of Asynchronous Distributed Alternating Direction Method of Multipliers
Ermin Wei, Massachusetts Institute of Technology, 32-D640 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, erminwei@mit.edu, Asuman Ozdaglar

We consider a network of agents that are cooperatively optimizing a problem with separable objective functions and linear coupling constraints. Recent literature studied distributed solutions through either subgradient based methods with slow convergence rate or Alternating Direction Method of Multipliers (ADMM) based methods, which require a synchronous implementation. In this paper, we present a novel asynchronous ADMM based distributed method and show that it converges at rate O(1/k).

3 - On Threshold Models over Finite Networks
Elie Adam, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, eadam@mit.edu, Munther Dahleh, Asuman Ozdaglar

We study a model for cascade effects over finite networks based on a deterministic binary linear threshold model. We first characterize the limiting behavioral properties of the dynamics. We then study the complexity of decision/counting problems that arise within the context. We finally propose a measure of network resilience that captures the nature of the involved dynamics, prove bounds and investigate the resilience of different network structures under this measure.

4 - Network Volatility
Qingqing Huang, Massachusetts Institute of Technology, Bldg 32-D760, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, qqh@mit.edu

We address the problem of identifying the most volatile node in a network. For a networked dynamic system in the presence of exogenous disturbances, we propose a measure of volatility at each node. We show how this measure depends on the structural properties of the underlying network, parameterized by an undirected graph. We investigate some stylized graphs and compare our measure against other measures. We also propose a distributed algorithm to compute the measure for large scale networks.

■ WD34

Level 2 - Room 211D

Simulation and Optimization Applications in Manufacturing

Sponsor: Simulation Society

Sponsored Session

Chair: Demet Batur, University of Nebraska-Lincoln, CBA 209, cLincoln, NE, 68516, United States of America, dbatur@unl.edu

1 - Using a Math-heuristic to Optimize Mixed Model Assembly Lines in Low-volume Manufacturing
Alexander Biele, EADS Innovation Works, Neflpriel 1, Hamburg, 21129, Germany, Alexander.Biele@eads.net, Lars Moench

An optimization problem for mixed model assembly lines in the aerospace industry is researched. We minimize the total inventory and labor costs of an assembly line assuming a given job (airplane) sequence. A VNS approach is used to find an appropriate number of workers for each station and cycle times for jobs on stations. The evaluation of a move requires the solution of a linear program to determine the start dates for the jobs. Results of computational experiments are presented.

2 - Estimating Cycle Time Quantiles using Quantile-Regression Based Metamodels

Demet Batur, University of Nebraska-Lincoln, CBA 209, Lincoln, NE, 68516, United States of America, dbatur@unl.edu, Jennifer Bekki

Simulation models of semiconductor manufacturing facilities are quite complex and can take a prohibitively long amount of time to run. Being able to predict delivery times for future configurations of the manufacturing system is critical and requires the ability to estimate the cycle time distribution. We present a quantile-regression based metamodeling approach and demonstrate its applicability to predicting cycle time quantiles of a simplified semiconductor manufacturing system.

3 - Using Renewable Energy to Power Hi-tech Manufacturing Facilities: A Simulation Study

Jesus Jimenez, Associate Professor, Texas State University, Ingram School of Engineering, 601 University Dr, San Marcos, TX, 78666, United States of America, Jesus.Jimenez@txstate.edu, Victor Santana-Rios, Tongdan Jin

In this research, simulation and optimization models are applied for designing distributed energy generation systems, the paradigm for producing electricity through solar photovoltaic (PV) and wind turbines (WT). Distributed generation can be integrated into manufacturing facilities, particularly in semiconductor wafer fabs, seeking to reduce electricity costs and carbon footprints. A case study is presented to demonstrate opportunities and obstacles of the distributed generation approach.

■ WD35

Level 2 - Room 212A

Robust Optimization II

Contributed Session

Chair: Jens Bengtsson, UMB School og Economics and Business, PO Box 5003, Aas, Norway, jens.bengtsson@umb.no

1 - A Robust Optimization Approach for Centralized Planning in Retail Inventory Management

Nishant Mishra, Rotterdam School of Management, Erasmus University, Rotterdam, Netherlands, nmishra@rsm.nl, Adriana Gabor, Eduardo Bastida

We propose a novel robust optimization approach for inventory management in retail operations that not only take into account demand uncertainty at each store, but also captures behavioral aspects, such as the willingness of store managers to cooperate with each other with regards to the lateral transshipments of products.

2 - Robust Multi-period Inventory Control Problem under Lead Time Uncertainty

Andreas Thorsen, Graduate student, Pennsylvania State University, 310 Leonhard Bldg, University Park, PA, 16802, United States of America, aht105@psu.edu, Susan Xu, Tao Yao

Calculating optimal inventory ordering policies for systems under lead time uncertainty is essential to reduce costs. Order crossover (the delivery of orders in a sequence different than placement) makes the problem challenging. The state space of dynamic programming approaches grows quickly. We develop a model for inventory control under lead time uncertainty using a robust optimization framework which allows order crossovers. We consider basestock and affinely adjustable policies.

3 - Robust Planning of Guaranteed Targeted Display Advertising

Huaxiao Shen, PhD Candidate, City University of Hong Kong, Department of Management Sciences, Tat Chee Avenue, Kowloon Tong, Kowloon, Hong Kong, Hong Kong - PRC, shenhx@cityu.edu.hk, Yanzhi Li

We study the ads serving problem for guaranteed targeted display advertising. We derive a closed-form measure for the audience reach and propose a chance constrained programming model for maximizing the reach. An efficient algorithm is designed to solve large scale instances. Numerical studies show that our approach outperforms the existing methods.

4 - Robust Planning of Oil Refineries – Uncertainty Constraints and Hedging

Jens Bengtsson, UMB School of Economics and Business, PO Box 5003, Aas, Norway, jens.bengtsson@umb.no, Patrik Flisberg, Mikael Ronnqvist

Several studies indicate relationships between changes in product prices and crude oil prices and vice versa. From robust optimization and refinery supply chain planning perspectives it is of interest to analyze how these relationships can be formulated in terms of uncertainty constraints and how they will affect supply chain planning, risk exposures and cost of robustness.

■ WD36

Level 2 - Room 212B

Health Care X: Performance Enhancing Strategies

Contributed Session

Chair: Jodi Grimm, Unit Head, Mayo Clinic, Systems & Procedures, CE-1, 200 1st St. SW, Rochester, MN, 55901, United States of America, grimm.jodi@mayo.edu

1 - A Composite Meaningful Use Measure for Electronic Health Records Adoption

Sanchoy Das, Professor, New Jersey Institute of Technology, University Heights, Newark, NJ, 07102, United States of America, das@njit.edu, Balavignesh Thirumalainambi, Wenbo Cai

NJ-HITEC has conducted EHR-MU assessments at over 1000 physician offices. Fifteen core measures and ten menu measures are evaluated. The current EHR-MU evaluation is designed as a binary evaluation, and a physician is assessed as having achieved an acceptable level of use if they pass all core and a subset of the menu measures. Based on the evaluation data this research presents a composite measure which provide a continuous scale assessment of the EHR adoption and use level by a physician.

2 - The Effects of Competing on Service Mix Flexibility on Hospital Performance

Wei Wu, University of Tennessee, 916 Volunteer Blvd., Knoxville, TN, 37996, United States of America, wwwuad@hotmail.com, Bogdan Bichescu, Randy Bradley

This research studies the performance implications of competing on service mix flexibility, defined as a hospital's ability to quickly expand or focus its service mix in response to environmental changes. Using hospital-level discharge data from California hospitals, we build econometric models to estimate the linkages between changes in service mix and various clinical, operational, and financial measures of hospital performance.

3 - The Impact of Lean Implementation on Hospital Performance: A Contingency and Configuration Approach

Yong Taek Min, Ph.D. candidate, Boston University School of Management, 595 Commonwealth Avenue, Operations & Technology Management, Boston, MA, 02215, United States of America, ytmin@bu.edu, Joseph Restuccia, Michael Shwartz, Jay Kim

We assess the impact of lean principles implementation (LPI) on hospital performance by applying a contingency and configuration approach. In the contingency approach, we analyze the impact of individual lean principles on hospital performance by using hierarchical regression analysis. In the contingency approach, we develop patterns of LPI by using cluster analysis, and examine the relationship between LPI pattern and hospital performance by using analysis of variance.

4 - Evaluating the Effectiveness of Breast Cancer Screening for Women Aged 50-59

Laurent Caudrelier, University of Toronto, Bahen Centre for Information Technology, 40 Saint George street, Toronto, ON, M5S 2E4, Canada, laurent@mie.utoronto.ca, Sharareh Taghipour, Anthony Miller, Bart Harvey

Establishing an optimal breast cancer screening policy requires evaluating the influence of the disease's progression and covariates. However, the influence of prevalent cancers and the proportion of overdiagnozed cases are often neglected. Our research estimates these influences for the 50-59 age group of the Canadian National Breast Screening Study (CNBSS) by comparing the effectiveness of different screening modalities between their clinical result and those obtained by means of simulation.

5 - An Integrated Approach to Talent Management

Jodi Grimm, Unit Head, Mayo Clinic, Systems & Procedures, CE-1, 200 1st St. SW, Rochester, MN, 55901, United States of America, grimm.jodi@mayo.edu, Steven Bahnemann, Rebecca Blegen, Anthony Chihak, Dorothy Larsen, Julie Yost, Jan Jasperson, Aric Knutson

This comprehensive Talent Management program identifies, assesses, develops and tracks talent within Systems & Procedures, Mayo Clinic's internal business consulting and management engineering division. The program, designed to develop and retain world class talent, has technical and leadership tracks to support the strategic vision and initiatives of Mayo Clinic and the needs of its patients.

■ WD37

Level 2 - Room 213A

Scheduling Manufacturing Operations

Contributed Session

Liang Zhang, University of Wisconsin-Milwaukee, 3200 N. Cramer Street, EMS 307, Milwaukee WI, 53211, United States of America, liangzh@uwm.edu

1 - Production Scheduling with the Consideration of Energy Consumption per Unit Time

Liang Zhang, University of Wisconsin-Milwaukee, 3200 N. Cramer Street, EMS 307, Milwaukee WI, 53211, United States of America, liangzh@uwm.edu

In the previous researches on production scheduling, they have focused on the minimization of total energy consumption. However, the amount of energy consumption per unit time is more important and practical in the limited energy situation. Basic charge depending on the contracted amperage goes up when the factory uses energy beyond the contract. In this paper, we propose a scheduling method to ensure that energy does not exceed the amount of the provision of energy and maintain productivity.

2 - Lot Streaming in the Presence of Learning Effects

Niloy Mukherjee, PhD Candidate, Virginia Tech, 250 Durham Hall, Virginia Tech, Blacksburg, VA, 24061, United States of America, niloym@vt.edu, Subhash Sarin

We present a solution method for lot streaming problems that permit the incorporation of the effects of learning. A polynomial-time transformation is presented that converts a problem with learning effects to its corresponding constant-processing-time case. This allows the use of existing solution methods in the literature even when learning is present. The scope of the transformation is discussed, and we also show that no such transformation exists for the non-homogenous learning case.

3 - Performance Evaluation of Serial Production Lines with Geometric Machines during Transients

Liang Zhang, University of Wisconsin-Milwaukee, 3200 N. Cramer Street, EMS 307, Milwaukee, Wi, 53211, United States of America, liangzh@uwm.edu, Jorge Arinze, Guoxian Xiao, Guorong Chen, Chuanfeng Wang

Transient behavior of production systems has significant practical and theoretical implications. In the framework of serial lines with geometric machines and finite buffers, we develops mathematical models for transient analysis and derives formulas for evaluating the performance measures during transients. In addition, a computational efficient procedure is developed to approximate the transient production rate. The results can be applied to systems with time-varying system parameters.

■ WD38

Level 2 - Room 213B

Supply Chain Management II

Contributed Session

Chair: Yi Yang, Assistant Professor, Zhejiang University, Hangzhou, China, yangyicuhk@gmail.com

1 - Business Process Outsourcing: Managing Service Quality

Samar Mukhopadhyay, SKK University GSB, 53 Myungryun-dong 3-ga, Jongno gu, Seoul, 110-745, Korea, Republic of, samar@skku.edu, Guangliang Ye, Xiaowei Zhu

BPO increases profit from several operational advantages, but lack of control over service quality is a problem. Differential quality from service providers can be a source of irritant for the OEM's customers. We propose that the volume allocation can be a motivator for quality improvement. This also equalizes the equilibrium service quality. Optimum volume allocation policies for the OEM and quality improvement strategies for the suppliers, including an asymmetric information case are obtained.

2 - Simultaneous Contract and Spot Market Procurement by a Risk Averse Firm

Arnab Bisi, Associate Professor of Operations Management, Indian Institute of Management Calcutta, Joka, Diamond Harbour Road, Kolkata, WB, 700104, India, abisi@iimcal.ac.in, Shlomo Levental, Santosh Mahapatra, Ram Narasimhan

We study simultaneous procurement from "contractual" and "spot market" arrangements for a risk-averse firm that adopts dual sourcing strategy to purchase a standardized product. The arrangements involve deterministic and stochastic price processes, respectively. Models and insights are developed for the optimal procurement policy for both exogenous and endogenous contract prices.

■ WD41

Level 1 -101A

Service Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Sameer Hasija, Insead, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, sameer.hasija@insead.edu

1 - Setting Quality and Speed in Service Industry with Repeated Customers

Azin Farzan, The University of Washington, The Michael G. Foster School of Business, The University of Washington, Seattle, WA, 98195, United States of America, afarzan@uw.edu, Yong-Pin Zhou

We analyze quality, capacity, and pricing decisions for a system in which customers purchase service repeatedly. We consider different aspects of quality, capacity and pricing decisions on customer behavior and provide a general model that provides insights on the optimal levels of these decisions and their relationships.

2 - Optimal Contracts for Outsourcing of Repair and Restoration Services

Nitish Jain, INSEAD, Singapore, 138676, Singapore, nitish.jain@insead.edu, Dana Popescu, Sameer Hasija

Outsourcing of repair services creates double-sided moral hazard issues since the system performance is determined by joint efforts of the client and the vendor. Additionally, performance-based contracts coupled with stochasticity in the service performance may raise financial concerns for the vendor. We present optimal contracts that resolve such agency issues.

3 - Optimal Promotion Strategy for a Service Firm with Delay Sensitive Customers

Guangwen Kong, University of Southern California, Marshall School of Business, Los Angeles, United States of America, Guangwen.Kong.2013@marshall.usc.edu, Ramandeep Randhawa

Online social advertising tools such as Groupon generate new business for service providers and at the same time generate new challenges. Discount-seeking customers may impose externalities on the system that could drive away regular customers. We analyze these trade-offs and devise recommendations as to when would Groupon promotions be beneficial.

4 - Information Acquisition for Product Portfolio Selection

Nektarios Oraiopoulos, University Lecturer in Operations Management, Judge Business School, Cambridge University, Trumptington St., Cambridge, United Kingdom, n.oraiopoulos@jbs.cam.ac.uk, Jochen Schlapp, Vincent Mak

Every product portfolio manager is challenged by the limited information that she has available when allocating resources across multiple products. Her task is further complicated when this information is obtained from self-interested managers who might have an incentive to be overly optimistic about their own products. Our work studies how balancing individual and shared incentives can mitigate such inefficiencies and improve the product selection process.

■ WD42

Level 1 -101B

Empirical Service Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Antonio Moreno-Garcia, Northwestern University a-morenogarcia@kellogg.northwestern.edu

1 - Price Optimization: A Field Experiment in Online Retailing

Jun Li, Assistant Professor, Ross School of Business, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu, Marshall Fisher, Santiago Gallino

Many retailers track competitors' prices on a daily basis. However, how to respond to this information is not well understood in practice. The answer is dependent upon consumer substitution patterns among competing retailers as well as across similar products. We conducted a field experiment and developed an estimation framework to obtain self- and cross- price elasticities with limited information of consumer choices (known competitors' prices but unknown choices over competitors' products).

2 - Operational Transparency in Face-to-Face Service Settings: The Effects on Customers and Employees

Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu, Tami Kim

It has been established that operational transparency improves customer perceptions of value and diminishes sensitivity to waiting in online settings. However, its effects have not been explored in face-to-face settings, where wait times are longer, processes are more variable, and customers can influence service outcomes through their interactions with employees. We present the results of two field experiments and two lab experiments, conducted in food service settings.

3 - How Delay Announcements Shape Customer Behavior: A Field Experiment Study

Qiuping Yu, Northwestern University, Evanston, IL, United States of America, QiupingYu2009@u.northwestern.edu, Gad Allon, Achal Bassamboo

We explore the impact of delay announcements by conducting a field experiment at a medium sized call center. Specifically, we study and compare the call center performances where announcements of different granularity are provided. We also contrast this against the benchmark where no information is provided.

4 - An Econometric Analysis of Patients Who Leave the ED without Being Seen by a Physician

Ehsan Bolandifar, The Chinese University of Hong Kong, Shatin, NT, Hong Kong, Hong Kong, Hong Kong - PRC, ehsan@baf.cuhk.edu.hk, Tava Olsen, Nicole DeHoratius

We present an empirical study of an emergency department (ED) in which patients may leave the waiting area without being seen by a physician (LWBS). Using operational data from a hospital ED, we show that wait time and number of patients in the waiting area significantly affect LWBS probability. In addition, observed service volume may affect LWBS probability but the magnitude of its effect depends on other factors. Our findings have implications for the management of hospital EDs.

■ WD43

Level 1 -101C

Outsourcing

Contributed Session

Chair: Taimaz Soltani, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, T.Soltani@tue.nl

1 - Manufacturer's Profit in Maintenance Outsourcing with Menu Contract

Andy Alexander, Purdue University, 6111 Eagles Nest Blvd., Zionsville, IN, United States of America, alexan11@purdue.edu, Robert Plante, Yanjun Li

We use principal-agent theory to study maintenance contract between manufacturer and contractor. The manufacturer acquires probabilistic information on the contractor's cost for corrective maintenance and offers menu contract for the timing and payment for preventive maintenance. Two contracts are compared: manufacturer as principal, and system as principal. We find that, for a significant portion of cost range, the manufacturer can be more profitable using the contract with system as principal.

2 - Customized Store Brands: Production Outsourcing to National Brand Manufacturer

Reiya Hara, Keio University, Hiyoshi 3-14-1 Kohoku-ku, Yokohama, Japan, reiya.hara31@gmail.com, Nobuo Matsubayashi

We explore a customized store brand (SB) that effectively matches consumers' preferences. With regard to its production, the SB retailer benefits from outsourcing to a national brand (NB) manufacturer who has sophisticated technology. However, the NB manufacturer might suffer from cannibalization between the NB and the SB, implying that strategic coordination is needed to realize this outsourcing. We investigate this coordination problem by a game-theoretic approach.

3 - Sustainable Operations under Cost Pressure and Poor Legal Enforcement Conditions

Mariya Bondareva, PhD Student, University of Rochester, CPU Box 272863, University of Rochester, Rochester, NY, 14627, United States of America, mariya.bondareva@Simon.Rochester.edu, Edieal Pinker

We study the enforcement of supplier compliance with sustainability requirements when production is outsourced to developing countries. With poor legal enforcement, relational contracts are used to address such quality issues as hazardous product chemical content. We determine when the buyer's cost pressure policy is efficient or harmful to sustainable production. Collaborative approaches to compliance with sustainability goals may ultimately be more productive than punitive policies.

4 - An Experimental Study of Outsourcing through Competition

Ehsan Elahi, Assistant Professor, University of Massachusetts, Boston, 100 Morrissey Blvd, Boston, MA, 02125, United States of America, ehsan.elahi@umb.edu, Roger Blake, Surya Dantuluri

In this research, we try to study the decision making behavior of suppliers who compete for the demand share of a buyer. We use laboratory experiments to see how suppliers' decisions deviate from the theoretical results. We also propose theories to explain this deviation. Our observations show that the inventory decisions of suppliers converge at a higher level than the theoretical Nash equilibrium. This could be due to the gamesmanship behavior of the players.

5 - Optimal Policies based on Stochastic Control for Production Outsourcing Decisions

Taimaz Soltani, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, T.Soltani@tue.nl, Arun Chockalingam, Jan Fransoo

We consider a firm that can outsource a portion of its production to an external firm. The profit per unit produced at each location is modeled by a stochastic process. Optimally selecting internal and outsourced production proportions can both increase profit and hedge the firm against future uncertainties. We formulate the outsourcing decision of the firm as a stochastic control problem and derive optimal control policies that help the firm make time-appropriate outsourcing decisions.

■ WD44

Level 1 -101D

Supply Chain: Design and Services

Contributed Session

Chair: Timothy Sprock, Georgia Institute of Technology, 755 Ferst Dr, Atlanta, GA, 30332, United States of America, tsprock3@gatech.edu

1 - Impacts of Modeling Decisions on the Quality of Supply Chain Network Design Solutions

Marc-Andre Carle, Research Fellow, Université Laval, 1065, Av. de la Médecine, Quebec, QC, G1V0A6, Canada, marc-andre.carle@forac.ulaval.ca, Marie-Claude Bolduc, Sophie D'Amours

Several mathematical models have been proposed to solve supply chain network design problems. In particular, different strategies can model several key design decisions such as location, capacity and technology selection. Cost and inventory models (linear or concave) also differ significantly between approaches. We model several supply chains from different industries using various MIP formulations. Differences between optimal designs selected by each model will be outlined.

2 - Designing a Distributor Compensation Scheme using Game Theory

Cinthia Perez, Research assistant, University of Florida, 303 Weil Hall, PO Box 116595, Gainesville, FL, 32611-6595, United States of America, ccperez@ufl.edu, Joseph Geunes

Consider a set of distributors and retailers, where one of the distributors is contractually obligated to serve any retailer who requests service, but the retailers have the option of choosing any distributor. We model this problem as a game in which the goal is to design a distribution compensation scheme that is profitable for the distributor and attractive to the retailers, and such that as many retailers as possible would prefer the contracted distributor to the other alternatives.

3 - A Two-echelon Transportation-inventory Problem in Steel Industry

Defeng Sun, Northeastern University, Shenyang, 110819, China, sdftli@163.com, Lixin Tang

We considered an integration problem of transportation, location and inventory to meet the actual needs of raw material supply chain management in the steel industry, involving two-echelon transportation structure, uncertain demand and safety stock consideration. The problem is formulated as an integer-programming model, and optimization tools based on the combination of Benders decomposition and branch & cut algorithm are established for this problem.

4 - An Approach to Modeling Early Life Cycle Supply Chains

Timothy Sprock, Georgia Institute of Technology, 755 Ferst Dr, Atlanta, GA, 30332, United States of America, tsprock3@gatech.edu, Leon McGinnis

Designing and analyzing a new supply chain is a challenge because knowledge of final suppliers and BOM details as well as their performance characteristics are unavailable. We construct a framework in OMG SysMLô to categorize suppliers and components, which allows us to integrate performance data from legacy supply chains to model the expected performance of the target supply chain. The framework can be used to refine both the structure of the model and the properties of the components.

■ WD45

Level 1 -101E

Supply Chain and Game Theory

Contributed Session

Chair: Mericcan Usta, PhD Candidate, Stanford University, 245 Huang Engineering Center, Stanford, CA, 94305, United States of America, usta@stanford.edu

1 - Supply Licensing when the Manufacturer Strategically Commits to Invest in R&D

Mericcan Usta, PhD Candidate, Stanford University, 245 Huang Engineering Center, Stanford, CA, 94305, United States of America, usta@stanford.edu, Feryal Erhun, Warren H. Hausman

We propose a strategic reason for a proprietary component supplier to license her technology to a competitor: her anticipation of the manufacturer's commitment to invest in research and development (R&D). We address this phenomenon with a game theoretic model. The manufacturer's full commitment to invest in R&D enables the supplier to license more often, sell a larger quantity through the supply chain, and charge lower prices than the manufacturer's full commitment not to invest in R&D.

■ WD46

Level 1 -101F

Green Supply Chain Management

Contributed Session

Chair: Yann Bouchery, Ecole Centrale Paris, Grande Voie des Vignes, Chatenay-Malabry, 92290, France, yann.bouchery@ecp.fr

1 - Design of the Sustainable Hybrid Bioethanol Supply Chain under Uncertainty

Jun Zhang, Assistant Professor, North Dakota State University, IME Department, Fargo, ND, 58102, United States of America, Jun.Zhang@ndsu.edu, Vinay Gonela

Bioethanol is becoming increasingly attractive for the reasons of energy security, diversity, and sustainability. This paper proposes a stochastic mixed integer linear programming model to design an optimal integrated 1st and 2nd generation bioethanol supply chain that will consider sustainability under various uncertainties. The case study demonstrates the effectiveness of the proposed model and managerial insights are obtained as well.

2 - Closed-loop Supply Chain Design for Uncertain Carbon Tax Rates and Stochastic Demands

Seyyed-Ali Haddad-Sisakht, Iowa State University, Black Hall, Ames, IA, 50011, United States of America, alihadad@iastate.edu, Sarah Ryan

We design a closed-loop supply chain network that is subject to long-term uncertainty in carbon tax rates and short-term randomness in demands and returns. We propose a three-stage model to locate facilities, contract for transportation capacity, and transport new and returned products. Results of implementing a tractable solution approach for the robust counterpart of this mixed integer program with stochastic sub-problems are discussed.

3 - A New Inventory Model of Cold Items Considering Supply Chain Emissions

Ali Bozorgi, University of Central Florida, 4136 Guadalupe Ct, Orlando, FL, 32817, United States of America, alililihozak@yahoo.com, Jennifer Pazour, Dima Nazzal

An inventory model is proposed for cold items considering economic and emission functions. Two algorithms are developed to optimize the functions. We provide insights from numerical experiments on the environment where the specialized inventory model is applicable, as well as the trade-off between the economic and emission functions.

4 - Motivating Suppliers' Environmental Performance via Pollution Abatement Investments

Qinqin Zhang, PhD Student, Stanford University, 84 Hulme Ct. Apt. 109, Stanford, Ca, 94305, United States of America, zhangqq02@gmail.com, Warren H. Hausman

We study the impact of a buyer's demand allocation mechanism on her suppliers' pollution abatement investment decisions and their corresponding environmental performance when the suppliers have heterogeneous abatement investment opportunities. We obtain Nash equilibria demonstrating a first-mover advantage regarding such investment abatement decisions.

5 - A Joint Transportation Mode Selection and Lot Sizing Optimization Model with Carbon Emissions

Yann Bouchery, Ecole Centrale Paris, Grande Voie des Vignes, Chatenay-Malabry, 92290, France, yann.bouchery@ecp.fr, Jan Fransoo, Asma Ghaffari, Zied Jemai

Curbing carbon emissions from transportation is a major step beyond the greening of the supply chain. In this research, we propose a new model that aims at jointly optimizing the transportation mode selection and the lot sizing decisions while taking carbon emissions into account. By performing a multiobjective optimization analysis, we show among others that switching to a greener mode of transportation while continuing to optimize the logistics costs function may lead to dominated solutions.

■ WD47

Level 1 -101G

Procurement and Purchasing

Contributed Session

Chair: Xiangling Hu, Grand Valley State University, 8011 Thornapple Club Dr. SE, Ada, Mi, 49301, United States of America, hux@gvsu.edu

1 - Inventory Strategies for International Non-Profit Healthcare Organizations

Annie I-An Chen, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, anniecia@mit.edu

For international non-profit healthcare organizations, medical supplies are often ordered infrequently and in bulk due to limited management resources, yet storage space constraints make it difficult to keep track of the large quantities of goods arrived. We present possible improvements of inventory strategies through the deployment of risk pooling strategies, reducing demand variability by aggregation across time (using blanket orders), and across space (pooling different locations).

2 - Risk-averse Procurement with Unreliable Supply

Lei Shu, Xi'an Jiaotong University, Shaanxi, Xi'an, Xianning West Road No.28, Xi'an, China, shulei@stu.xjtu.edu.cn, Feng Wu

Considering a risk-averse buyer with unreliable supply, this paper presents procurement models based on an exponential utility function. Mathematically proved, optimal solutions are unique, and the objective function is strictly concave in initial inventory level in each period, showing the effectiveness of inventory strategy. The optimal expected utility in single-period model strictly decreases in supply price, and is independent of maximum supply ratio.

3 - Optimal Pump Scheduling under Uncertainty in Water Networks

Nicole Taheri, Researcher, IBM Research, IBM Technology Campus, Server 3, Mulhuddart, Dublin 15, D, 15, Ireland, nicole.taheri@ie.ibm.com, Bradley Eck, Martin Mevissen

Optimizing pump schedules for a water network to minimize costs can be formulated as a mixed integer nonlinear optimization problem. Moreover, there is considerable uncertainty in water demand and potentially in pricing. We formulate an optimization model to find low-cost pump schedules that are robust to uncertainty. Our model uses a quadratic approximation for the nonlinear hydraulic equations. We implement a number of robust methods on a well-known test network and show numerical results.

4 - Comparison of Two Sourcing Mechanisms with Competitive Suppliers and Imperfect Information

Yue Jin, Researcher, Bell Labs Ireland, Alcatel-Lucent, Blanchardstown Busi. & Tech. Park, Dublin, 15, Ireland, yue.jin@alcatel-lucent.com, Jennifer Ryan

A two-stage sourcing mechanism composed of a qualification stage and a selection stage is typical with imperfect information on suppliers' costs and capabilities. We propose an alternative: the manufacturer offers a penalty/reward scheme based on supplier capabilities. The suppliers incorporate the impact of the scheme when competing. We show that this alternative reduces the manufacturer's overall costs even with free qualification in various scenarios, and compare different aspects of the two.

■ WD48

Level 1 -101H

Behavioral Operations in Group Settings

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Julie Niederhoff, Syracuse University, 721 University Ave., WSOM 500, Syracuse, NY, 13244, United States of America, jniederh@syr.edu

1 - Problem Formulation and Solution in Humanitarian Transportation Planning

Erica Gralla, Assistant Professor, The George Washington University, 1776 G Street Suite 101, Washington, DC, 20052, United States of America, egralla@gwu.edu, Jarrod Goentzel, Charles Fine

In many important operational settings, human decision-makers struggle not only to make good decisions but also to understand the nature, or formulation, of the decision itself. We study ten teams of expert humanitarian logisticians, to show the mechanisms by which humans formulate problems, and discuss their impact on the quality of their solutions. We find that humans employ search within a limited problem space defined by sensemaking, guided by goal-oriented decision rules.

2 - Group Identity and Forecast Sharing in Supply Chains

Ulrich Thoneman, University of Colgone, Germany, Ulrich.Thonemann@uni-koeln.de, Felix Papier, Torsten Gully

A production planner decides on order quantities and relies on demand forecasts from a demand planner for this decision. The more effort the demand planner invests, the better is the forecast. We analyze the effect of group identity on the effort that the demand planner invests. We develop a game-theoretical model and test the model in the lab. We find that increasing group identity increases the effort invested by the demand planner and that the production planner anticipates this effect.

3 - Group Size and Investment in Quality

Julie Niederhoff, Syracuse University, 721 University Ave., WSOM 500, Syracuse, NY, 13244, United States of America, jniederh@syr.edu

Supply chains are filled with people who have often conflicting objectives of group success versus personal success. We explore the effect of group size and inter-dependency on the overall output of a system in several metrics of operations management.

4 - Differences in Human Server Behavior Influenced by Queue Design

Julie Niederhoff, Syracuse University, 721 University Ave., WSOM 500, Syracuse, NY, 13244, United States of America, jniederh@syr.edu, Kyle Harshbarger, Maria Shunko

This study examines how human servers behave in queueing systems. Analytical work in queueing theory often assumes that servers work at the same speed and accuracy regardless of the setup of the queue, but behavioral theory suggests otherwise. Various queue setups are explored in a lab experiment in order to observe differences in speed and accuracy across different treatments.

■ WD49

Level 1 -101I

Service Systems: Technology Development and Adoption

Contributed Session

Chair: Jun-Yeon Heo, POSTECH, 4-316 QSL, POSTECH, San 31, Hyoja-Dong, Nam-Gu, Pohang, Kyunbuk, Pohang, Korea, Republic of, jy_heo@postech.ac.kr

1 - Development of a Service Testing Gap Model in Service Testing Laboratory Environment

Ki-Hun Kim, Ph D. Candidate, POSTECH, Quality Systems Lab., Dept. of IME, San 31, Hyoja-dong, Nam-gu, Pohang, 790-784, Korea, Republic of, kh_kim@postech.ac.kr, Ryeok-Hwan Kwon, Kwang-Jae Kim

Service testing laboratory is a VR-based facility which supports testing of services using the VR-modelling technique. The service testing in the laboratory unavoidably faces the gaps resulting from the difference between the real service environment and laboratory environment. As the gaps influence the quality of service testing, the gaps should be identified and addressed properly. This talk presents a model to understand how the gaps are formed and how they affect the service testing.

2 - Development of a Quality Evaluation Scheme for Product-service System: Customers' Perspective

Jun-Yeon Heo, POSTECH, 4-316 QSL, POSTECH, San 31, Hyoja-Dong, Nam-Gu, Pohang, Kyunbuk, Pohang, Korea, Republic of, jy_heo@postech.ac.kr, Kwang-Jae Kim, Hyun-Jin Kim

Product-Service System (PSS) is a type of business offering for fulfilling customers' needs through the integration of products and services. In developing PSS, it is important to evaluate PSS quality in customers' perspectives for reflecting customers' needs on PSS. Although there are many studies about PSS evaluation, they are not enough to evaluate PSS quality in customers' perspective. In this talk, we present a scheme for evaluating PSS quality in customers' perspective.

■ WD50

Level 1 -101J

Financial Operations Management Under Risk

Contributed Session

Chair: Gurkan Akalin, Assistant Professor, Eastern Illinois University, 4008 Lumpkin Hall, Charleston, IL, 61920, United States of America, giakalin@eiu.edu

1 - Dynamic Financial Hedging Strategies for a Storable Commodity

Zhan Pang, Lancaster University, Lancaster University Management School, Department of Management Science, Lancaster, LA1 4YX, United Kingdom, z.pang@lancaster.ac.uk, Panos Kouvelis, Qing Ding

Consider a firm managing a storable commodity in the presence of demand and price uncertainty. The objective is to coordinate the replenishment and financial hedging decisions to maximize the mean-variance utility of the terminal wealth over a finite horizon. We characterize the structure of optimal time-consistent policies and find that inventories and financial hedges can be substitutes in dynamic settings.

2 - Ops-Risk Management for Financial Institutions: Optimal Investment Strategy

Yuqian Xu, PhD Student, NYU Stern Business School, 44 West 4th St., New York, NY, United States of America, yxu@stern.nyu.edu, Jiawei Zhang, Michael Pinedo

We focus on the management perspective of operational risk for financial institutions, and study the optimal capital allocation problem to minimize the operational losses and control the risk volatility. We derive the optimal capital allocation policy and provide explicit guidelines for financial institutions to better manage operational risks.

3 - Support SME Suppliers with Joint Financial and Operational Strategy

Boray Huang, National University of Singapore, 1 Engineering Drive 2, E1A-06-25, Singapore, Singapore, isehb@nus.edu.sg, David Ming-Huan Chiang, Andy Wu

SMEs (Small & Medium Enterprises) usually have limited capital and face challenges to obtain fund for operations. If an SME supplier fails to fund its production in time, the delivery of critical components may be delayed and consequently hurts the performance of the entire supply chain. In this research, we study a supply chain with an unreliable SME supplier. We then discuss the buyer's sourcing and financial decisions to support the supplier and optimize its own profit.

4 - The Need of Change in Currency Risk Models for Strategic Supply Chains

Gurkan Akalin, Assistant Professor, Eastern Illinois University, 4008 Lumpkin Hall, Charleston, IL, 61920, United States of America, giakalin@eiu.edu

Previous models for currency risk management often suggest unnecessary and inefficient diversification of supply chain partners and avoidance of volatile markets. Such defensive methods of earlier two decades and benefits of more active management are studied in this research.

■ WD51

Level 1 -102D

Advances in Logistics

Contributed Session

Chair: Yossi Sheffi, Professor, Massachusetts Institute of Technology, 1 Amherst Street E40, Cambridge, MA, 02142, United States of America, sheffi@mit.edu

1 - Creative Newsvendor Experimentation with the Tradewind Business Software

Abraham Seidmann, Xerox Chair Faculty, Simon School of Business, University of Rochester, Rochester, NY, 14627, United States of America, avi.seidmann@simon.rochester.edu, Tong Wu

The Newsvendor problem represents a canonical research question in supply chain management. Using our Tradewind business software, this research is aiming at extending the literature of behavioral operations management by empirically investigating a few aspects of the Newsvendor decision making problem that have not been studied before.

2 - Benchmarking Manufacturer's Imports SC Network Complexity

Dinesh Pai, Penn State University at Harrisburg, 777 West Harrisburg Pike, School of Business Adminsitration, Middletown, PA, 17057, United States of America, drp18@psu.edu, Richard Young

Global supply chains contain significantly more participants and cost elements than their domestic counterparts. Previous research has decomposed supply chain complexity into product complexity, process complexity and network complexity. In this study we analyze the import processes of six US based organizations using data envelopment analysis (DEA).

3 - Agglomeration and Collaboration of Logistics Operations

Liliana Rivera, PhD Candidate, Massachusetts Institute of Technology, 1 Amherst Street E40-222, Cambridge, MA, 02142, United States of America, mlrivera@mit.edu, Yossi Sheffi

This research analyses the relationship between the agglomeration of logistics firms and collaboration between them. Interview data suggest that logistics operations located close to each other experience higher levels of collaboration. Using a structural equation model based on data from a special survey conducted in Spain, we test and show that collaboration is enhanced by geographical proximity.

4 - An Improved Multimodal Transportation Scheduling System Based on IOT

Hongbo Li, IBM, Building 19-A, Zhongguancun Software Par, Beijing, China, hboli@cn.ibm.com, Li Zhang, Xin Shi, Hong Wei Ding

Multimodal transportation is an effective way to save logistics cost, however how to schedule efficiently is a key challenge. We present an improved scheduling system frame based on IOT(Internet of things) for multimodal transportation. The system integrates the level indicator, GPS and GIS to obtain the real-time multimodal pipeline inventory. Through integrating the overall situation, the multimodal transportation scheduling can achieve the whole operation efficiency.

■ WD52

Level 1 -102E

Freight Policy

Sponsor: Transportation Science & Logistics/Freight Transportation & Logistics

Sponsored Session

Chair: Rodrigo Mesa-Arango, Purdue University, West Lafayette, IN, United States of America, rmesaara@purdue.edu

1 - Dynamic Capacity Leasing and Order Processing in Intermodal Freight Transportation

Ting Luo, UT Dallas, UT Dallas, Dallas, United States of America, tingluo2006@gmail.com, Long Gao

We study a dynamic container leasing and load acceptance problem where both demand and capacity supply are random. We characterize the structure of the optimal policy and investigate the impact of system parameters. Using real-world data, we quantify the performances of several widely used policies with that of the optimal policy.

2 - Analysis of Changes in Freight Distribution from Major Capacity Expansion Projects

Sanghyeon Ko, Ph.D Student, University of Illinois at Chicago, 842 W. Taylor Street B19, Chicago, IL, 60607, United States of America, sko21@uic.edu, Kouros Mohammadian, Behzad Karimi

The U.S. major ports receive 80% of total container freight and redistribute to the states. The Panama Canal and the port of Prince Rupert in Canada will double their capacity from 2015 and 2020 and assuming to change receiving calls at ports from current status. Thus, optimization of the container flow from Asia will be analyzed considering commodity, port capacity, inland modes, and shipping costs. Results found that both expansions affected distribution from Asia to the U.S. major ports.

3 - A Behavioral Model to Understand the Qualitative Attributes in Freight Contracts

Satish Ukkusuri, Professor, Purdue University, 550 Stadium Mall Drive, West lafayette, IN, 47906, United States of America, sukkusur@purdue.edu, Rodrigo Mesa-Arango

Previous research shows that shippers do not always select the cheapest option when assigning contracts to carriers. Thus, shippers deny some cost savings by selecting carriers with attributes for which they are willing to pay more. This research applies a survey over a sample of shippers and uses econometric modeling to determine the monetary values that the shipper perceive for several attributes of the carriers.

4 - Exploring the Opportunities and Barriers to Rail/Truck Multimodal Freight

Yuntao Guo, Purdue University, 550 Stadium Mall Drive, School of Civil Engineering, West Lafayette, In, 47907, United States of America, guo187@purdue.edu, Srinivas Peeta

This study seeks to explore the opportunities and barriers of rail/truck multimodal freight transportation by using a survey based approach conducted over freight shippers, railway carriers and truck carriers. A clear understanding of these opportunities and barriers can provide indicators for potential of collaborative win-win and growth opportunities for all the sectors involved.

■ WD53

Level 1 -102F

Multimodal Transportation Operations

Contributed Session

Chair: Shayan Khoshmagham, Graduate Research Assistant, University of Arizona, 1488 E. Hedrick Drive, Apt. # 1202, Tucson, AZ, 85719, United States of America, shkhoshmagham@email.arizona.edu

1 - Multi-departure Parcel Distribution Timetabling

Omar Ben-Ayed, Professor, Qatar University, College of Business and Economics, PO Box 2713, Doha, Qatar, omar.benayed@qu.edu.qa

Parcel distribution timetabling problem is concerned with minimizing the shipping time that parcels spend in their journey from origins to destination. The movements from one facility to another are usually assumed to be performed once a day. However, such an assumption may lead to suboptimal or even unreasonable solution. The multitude of departures introduces considerable complexity to the formulation; but, it usually introduces as well considerable improvement to the generated timetable.

2 - Assessment of Performance Measures for Multimodal Transportation Systems

Shayan Khoshmagham, Graduate Research Assistant, University of Arizona, 1488 E. Hedrick Drive, Apt. # 1202, Tucson, AZ, 85719, United States of America, shkhoshmagham@email.arizona.edu, Larry Head, Wanjing Ma

This paper introduces an approach to visualization of multimodal performance measures. Radar diagrams are constructed for performance measures, e.g. delay, throughput, and stops for vehicles, transit, trucks, and pedestrians for each movement at an intersection or in a network. Before and after data can be visualized on the same diagram.

3 - Competitive Allocation Rules for Cooperative Truckload Delivery Games

Behzad Hezarkhani, Postdoc, Technical University of Eindhoven, OPAC, Department of Industrial Engineeri, Eindhoven, Netherlands, b.hezarkhani@tue.nl, Marco Slikker, Tom van Woensel

The highly competitive nature of logistics markets requires consideration for both competitiveness and fairness in allocating joint savings. We introduce basic properties which postulate the notions of fairness and competitiveness in simplified truckload delivery situations and propose allocation rules that satisfy these properties in all situations. We discuss that none of the existing allocation rules in the literature could satisfy these desirable properties.

■ WD55

Level 1 -103B

Strategic Planning and Decision Making

Contributed Session

Chair: Peng Liu, Xi'an Jiaotong University, No. 28 Xianning West Road, Xi'an, China, liup67@gmail.com

1 - Foreign-native Differences in Strategic Decisions under Uncertainty as Cause of Foreigners Liability
Jörg Zimmermann, European Commission - Joint Research Centre, Calle Inca Garcilaso 3, Seville, 41092, Spain, jzi@gmx.de

I argue on the basis of the comparative ignorance hypothesis that foreign decision-makers tend to perceive decisions under uncertainty as choices under ambiguity instead of risk. As a consequence, they are more likely to avoid new opportunities which cause a relative performance disadvantage. Empirical findings for business owners' decision to invest in their companies' assets, the decision to change industrial sectors, and the subsequent performance implications support the hypotheses.

2 - Dealing with the Wickedness of Strategy
Peng Liu, Xi'an Jiaotong University, No. 28 Xianning West Road, Xi'an, China, liup67@gmail.com, Youmin Xi

In four decades of research since the publication of Rittel and Webber's (1973) seminal paper, researchers have made a great deal of knowledge on how wicked problems are dealt with (Camillus, 2008; Conklin, 2005; Roberts, 2000). Nevertheless, the prevailing ways of coping with wicked problems remain disordered. We take a process approach to strategy and develop a framework of tackling wicked problems. Further, we use a case from China to illustrate our arguments.

3 - Strategic Business Consulting and Management Engineering
Chris Schieffer, Mayo Clinic, 200 1st St., SW, Rochester, MN, 55905, United States of America, schieffer.chris@mayo.edu, Amy Donahoe-Anshus, Joan Bryant-Mandler, Michele Hoover, Janine Kamath, Carrie Macken

This session details the Mayo Clinic model for Strategic Business Consulting and Management Engineering along with proven, integrated technical and soft skills essential to be a high performing business consultant. The structured model incorporates project, life cycle, knowledge and change management to deliver consistently effective services leading to high client satisfaction. Critical skills to sustain a trusted advisor relationship with clients and the organization will also be highlighted.

4 - HR Planning with AHP
Baris Carikci, TUBITAK, Kocaeli/ Gebze/T‹SSIDE, Istanbul, Turkey, bcarikci@yahoo.com

It is diffucult to evaluate service work force planning. Most of them are unmeasuable. In this reserach, we calculated the weight of procesess of each job by using AHP and then one measurebale process was measured in terms of time and tasks in the process. The total work was recalculated by propotion.

■ WD56

Level 1 -103C

Integration of Renewable Generation to the Smart Grid and Demand Response

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Enes Bilgin, Boston University, 1949 Commonwealth Ave., Apt 56, Brighton, MA, 02135, United States of America, enes@bu.edu

1 - Price Based Adaptive Control of Duty Cycle Appliances for Regulation Service Provision
Enes Bilgin, Boston University, 1949 Commonwealth Ave., Apt 56, Brighton, MA, 02135, United States of America, enes@bu.edu, Michael Caramanis

We propose a price-based policy to control the aggregate consumption of a collection of Duty Cycle Appliances (DCAs) in response to the Regulation Service (RS) signal brodacasted by the Independent System Operator (ISO). We develop a framework that learns the optimal pricing policy without requiring information on the current or forecasted state of specific DCAs. Numerical results show that our model succeeds in tracking the RS signal and is resilient to changes in DCA dynamics.

2 - Optimal Investment of Renewable and Conventional Assets
Wuhan Desmond Cai, California Institute of Technology, 1200 E. California Blvd., MC 305-16, Pasadena, CA, United States of America, wccai@caltech.edu, Yunjian Xu, Steven Low

It is expected that the costs of solar energy will be on par with conventional energy in the coming years. However, a large fraction of conventional energy costs are due to fixed assets which are amortized over at least twenty years. We study the problem of optimal investment of two fixed assets (conventional and renewable generation) where the price of renewable generation decreases over time. We characterize the optimal investment strategy and give insights on optimal cost allocation rules.

3 - Demand Response with Parameterized Supply Function Bidding
Yunjian Xu, Singapore University of Technology and Design, Engineering Systems and Design, Singapore, Singapore, xuyunjian@gmail.com, Na Li, Steven Low

When electricity supply and demand are imbalanced, a certain amount of load has to be adjusted by consumers. We seek to allocate the total amount of load adjustment to multiple consumers so as to minimize the aggregate consumer disutility. We propose a simple market-clearing mechanism that encourages consumers to reveal their private information by compensating their utility losses. We show that the proposed market mechanism yields bounded efficiency loss at a Nash equilibrium.

4 - AC Chance Constrained Optimal Power Flow
Michael Chertkov, Los Alamos National Laboratory, MS B213, Los Alamos, NM, 87545, United States of America, chertkov@lanl.gov, Russell Bent, Daniel Bienstock

Typical implementations of the Optimum Power Flow (OPF) minimize the cost of generation, subject to linearized, so-called DC, power flows, thermal capacity, ramping and security constraints. Here we extend our recent results and develop the Chance Constraint (CC) OPF which manages risk in a principled fashion by allowing physical constraints to be violated with small probability while keeping some of the nonlinearities, in the underlying AC power flow equations, present.

■ WD57

Level 1 -103D

Facilitating the Participation of Stochastic Energy Resources in Electricity Markets

Sponsor: Energy, Natural Resources and the Environment/Energy

Sponsored Session

Chair: Juan Miguel Morales, Associate Professor, Department of Applied Mathematics and Computer Science, Technical University of Denmark, Matematiktorvet, building 303B, Kongens Lyngby, Denmark, jmmgo@dtu.dk

1 - Assessing the Integration of Wind Energy Producers in the Spanish Electricity Market
Miriam Bueno-Lorenzo, Assistant Professor, Universidad Carlos III de Madrid, Av Universidad, 30, Dpto. Ingeniería Eléctrica, Leganés (Madrid), 28911, Spain, mblorenz@ing.uc3m.es, Julio Usaola, M. Angeles Moreno

This work aims to study the participation of wind energy producers in the Spanish electricity market. Hence a tool which maximizes the incomes of wind power producers in electricity markets is employed. Through a stochastic process a strategic bidding algorithm is designed. It takes into account the variables involved in the process, namely wind power forecasts, market prices, as well as their forecasts. Moreover, a risk analysis is included in the results.

2 - On the Marginal Value of Energy Storage in Selling Random Wind
Eilyan Bitar, Cornell University, Ithaca, NY, United States of America, eyb5@cornell.edu, Pramod Khargonekar, Kameshwar Poolla

Wind is inherently random. In the following, we'll explore the extent to which energy storage can be used to mitigate quantity risk for wind power producers offering forward contracts in a two-settlement electricity market. In particular, we derive analytical expressions relating explicitly the marginal value of energy storage capacity to the spectral properties of the underlying wind power process.

3 - Trading Wind Power Optimally as a Price-making Agent in the Balancing Market
Marco Zugno, Danmarks Tekniske Universitet, Kgs. Lyngby, Denmark, mazu@dtu.dk, Pierre Pinson, Henrik Madsen, Juan Miguel Morales

In the state-of-the-art, wind power producers are always seen as price-takers. In contrast, we determine the optimal bid in the forward market (first-stage decision), considering the impact on prices of the energy exchange in the balancing market (recourse decision). Such a price-maker relationship is modeled as a Mathematical Program with Equilibrium Constraints (MPEC), formulated as a MIP, while the uncertainty in wind power output and market quantities is accounted for by using scenarios.

4 - Restless Bandit Index Policies for Demand Response
Josh Taylor, University of Toronto, 10 King's College Rd., Toronto, Canada, josh.taylor@utoronto.ca, Johanna Mathieu

Electrical loads providing demand response are often not measurable until they have been deployed. Demand response algorithms must therefore balance utilizing good loads and learning about poorly characterized but potentially good loads; this is a manifestation of the classical tradeoff between exploration and exploitation. We derive restless bandit index policies to optimize this tradeoff for both when deployed loads are directly observable and when they only observable in aggregate.

■ WD59

Level 1 -103F

Education II: Education Performance

Contributed Session

Chair: Janet Wagner, Dean of Business, Richard Stockton College of NJ, 101 Vera King Farris Drive, Galloway, NJ, 08205-9441, United States of America, janet.wagner@stockton.edu

1 - Strengthening the Local IT Sector through Academic-industry-Government Collaborative Partnerships
Fortune Mhlanga, Lipscomb University, One University Park Drive, Nashville, TN, United States of America, fortune.mhlanga@lipscomb.edu, Frederick Scholl

Industry-Academic collaborative partnerships, and their relevance to economic development, have attracted a global attention in recent years. They complement each other in having knowledge and skills of great value to economic development. We recently initiated a new Computing and Informatics program with intentional bridges to industry and government. This paper discusses the successes of this program and its impact on the Nashville technology community.

2 - Effects of Scientific EXPO for Elementary Student's Attitudes Toward STEM Courses
Ling Zu, PhD candidate, Clemson University, Department of Industrial Engineering, Office151, Freeman Hall, Clemson, SC, 29634, United States of America, lzu@g.clemson.edu, Mary Kurz

This research examines several aspects that we hope have been affected by the Engineering Expo experience: placement of students in mathematics courses in this particular middle school, attitudes towards math and science, and attitudes towards higher education. By making a multivariate regression model, the paper determines the factors that affect students' choices and attitudes effectively.

3 - Maximizing Diversity in the Engineering Global Leadership Honors Program Cultural Families
Kayse Maass, University of Michigan, 503 Greenwich Dr, Apt M, Howell, MI, 48843, United States of America, leekayse@umich.edu, Mark Daskin, Anna Weiss, Vera Lo

We analyze the efficiency of two linear programming model formulations for allocating students into groups so as to maximize the cultural diversity within each group. These groups are maintained throughout the academic year and provide students with the opportunity to experience other cultures on a daily basis.

4 - Automated Test Assembly of IRT-based Multiple Forms: using an Ant Colony Optimization Algorithm
Pei-Hua Chen, National Chiao Tung University, Department of Management Science, Hsin-Chu, 116, Taiwan - ROC, peihuamail@GMAIL.COM, Wan-Yu Tsai

Three content balancing methods were proposed and incorporated with the Ant Colony Optimization approach for test assembly. 5 forms with test length of 40 were constructed from a 540-item bank. The results show that fixed content ratio performs the best in terms of the computation time and measurement precision.

5 - Rigor vs. Student Course Evaluations: What does the Data Say?
Janet Wagner, Dean of Business, Richard Stockton College of NJ, 101 Vera King Farris Drive, Galloway, NJ, 08205-9441, United States of America, janet.wagner@stockton.edu

If you make your course too tough, will you get bad student evaluations? Or will they "ding" you if they don't get their money's worth? This talk examines both the existing literature on this question, and reports on an analysis of a collegewide course-level data set incorporating end-of-term student course evaluations with registration system data (including final grades). Using some basic and not so basic statistical techniques, we report on patterns found.

■ WD60

Mezzanine - 100A

Data Mining for Healthcare Applications

Sponsor: Data Mining

Sponsored Session

Chair: Chi-Chang Chang, Chungshan Medical University, 110, Sec. 1, Chien-Kuo N. Rd., Taichung, 40100, Taiwan - ROC, changintw@gmail.com

1 - Analysis of Prognostic Factors in Patients with Relapsed Ovarian Cancer
Chi-Chang Chang, Chungshan Medical University, 110, Sec. 1, Chien-Kuo N. Rd., Taichung, 40100, Taiwan - ROC, changintw@gmail.com

Newly diagnosed ovarian cancer is very responsive to first-line therapy, but the majority of patients will have disease relapse. We developed five machine learning approaches were considered to find important prognostic factors to predict the relapsed ovarian cancer. Our findings suggest that three most important prognostic factors (Pathologic Stage, Pathologic T, Cell Type) and to improve surveillance after treatment might lead to earlier detection of relapse.

■ WD61

Mezzanine - 100B

Information Systems

Contributed Session

Chair: Zsolt Ugray, Associate Professor, Utah State University, Management Information Systems Departmen, 3515 Old Main Hill, Logan, Ut, 84322-3515, United States of America, zsolt.ugray@usu.edu

1 - Exploratory Study of E-tailing Service Reliability
Jin Qin, USTC, 96 Jinzhai Rd., USTC, Hefei, China, qjin@ustc.edu.cn, Qianqian Zhao

A questionnaire was developed to explore the dimensions of E-tailing service reliability. Data was collected and further analyzed through SEM analysis. Results indicate that e-tailing service reliability consists of four main dimensions: distribution reliability, information reliability, customer service reliability and web technology reliability. Among these dimensions, the most significant one is distribution reliability.

2 - Leadership Communication via Technology
Michael Chuang, State University of New York, 1 Hawk Dr, New Paltz, NY, United States of America, chuangm@newpaltz.edu

Due to outburst of business unethical events, ethical leadership is identified as a necessary solution. For today's virtual organizations, fast-developing technologies offer new chances for leaders' communication needs. However, as a new research topic, how technology fares and interacts with ethical leadership still remains a research domain not well charted. Hence this research investigates the ethical leadership between leader and follower in technology mediated communication environments.

3 - Information Security Policy Violation: Insights from the Role Theory
Pei-Lee Teh, Senior Lecturer, Monash University, Jalan Lagoon Selatan, Bandar Sunway, Selangor, 46150, Malaysia, teh.pei.lee@monash.edu, Pervaiz K Ahmed

Role theory is often used to examine the expected human behavior in a given situation. However, the application of role theory has been ignored in Information Security research. This study draws upon neutralization theory and role theory to develop an integrative model to predict employees' information security policy violation.

4 - What Preferences Influence the use of ICT Devices?
Zsolt Ugray, Associate Professor, Utah State University, Management Information Systems Departmen, 3515 Old Main Hill, Logan, Ut, 84322-3515, United States of America, zsolt.ugray@usu.edu, Eszter Monda

The proliferation of devices along the wide spectrum of information and communication technologies (ICT) presents opportunities and challenges to users. In this study we explore factors that help to explain users' preferences and predict their usage choices. Practical considerations and theoretical models are both considered.

■ WD64

Mezzanine - 100E

Risk Analysis

Contributed Session

Chair: Samrat Chatterjee, University of Southern California, CREATE, 3710 McClintock Avenue, RTH 322, Los Angeles, CA, 90089, United States of America, chatterjee.samrat@gmail.com

1 - Flexible Leasing Contracts in a Sustainable Fleet Replacement Model

Amir Hossein Ansaripoor, PhD Candidate, ESSEC Business School, 100 Victoria Street, National Library, Building, #13-02,Singapore 188064, Singapore, Singapore, amirhossein.ansaripoor@essec.edu, Fernando Oliveira

We study the fleet replacement problem taking into account the minimization of cost and risk, simultaneously, in a stochastic multi-period setting, using conditional value at risk. New engine vehicles are considered as an alternative solution to reduce fossil fuel consumption and greenhouse gas emission. We develop a model that considers the possibility of early termination of the leasing contracts using real options. We validate the results by a real world case study.

2 - Critical Risk Factors of ERP System Implementation of SMEs

Jiangao Deng, Associate Professor, Hohai University, 200 Jinling North Road, Changzhou, JS, 213022, China, djgwmdkx@hhu.edu.cn, Bih-Ru Lea, Fiona Fui-Hoon Nah

ERP are increasingly accessible to SMEs. The potential benefits of these systems are significant, risk management, an important content of project management, are also associated with the ERP system implementation. But how do SMEs actually find the critical risk factors of ERP system implementation? The research objective is to figure out the critical risk factors from the survey data of SMEs in China who had carried out ERP system implementation based on rough set theory.

3 - Analyzing Security Portfolios Amidst Uncertain Effectiveness

Samrat Chatterjee, University of Southern California, CREATE, 3710 McClintock Avenue, RTH 322, Los Angeles, CA, 90089, United States of America, chatterjee.samrat@gmail.com, Daniel Salazar, Stephen Hora

This study focuses on the analysis of tradeoffs between risk reduction and net economic costs associated with portfolios of urban area security measures. The epistemic uncertainty in portfolio effectiveness, due to limited expert information, is quantified using intervals. Portfolio selection is formulated as an optimization problem under interval uncertainty and efficient risk reduction/net cost frontiers with intervals are developed.

4 - Resilience and Risk Management in Analytics-Driven Enterprises

Raja Iyer, Dean, Prince Mohammad Bin Fahd University, College of Business Administration, Al Khobar, 31952, Saudi Arabia, riyer@pmw.edu.sa, Shaikh Arifusalam

Analytics align skills, technology, applications and best practices, analytics-driven enterprises to achieve continuous and iterative models to explore and explain past experiences, and predict, and optimize key performance indicators. Increasing dependence of enterprises and their stakeholders on site-based and mobile analytics calls for minimal disruptions due to unforeseen catastrophic events. This research presents frameworks and methods to ensure resilience and risk management in analytics-driven enterprises.

■ WD65

Mezzanine - 100F

Increasing Productivity in Manufacturing

Contributed Session

Chair: Xi Gu, Graduate Student, University of Michigan - Ann Arbor, 2300 Hayward St., Ann Arbor, MI, 48109, United States of America, xig@umich.edu

1 - Robust Manufacturing Lines Design with Work Sharing and Delayed Product Release

Ehsan Nazarian, PhD Candidate, University of Nebraska-Lincoln, W151 NH, Lincoln, NE, 68588, United States of America, enazarian@unl.edu, Jeonghan Ko, Hui Wang

A robust manufacturing line design may decrease the line efficiency by unnecessarily large cycle times. Reducing the cycle time may result in incomplete tasks. We propose a new approach to minimize cycle time and utilize idle times in under-loaded stations to absorb the effect of incomplete tasks. The extreme task time variations and postponed product release from overloaded stations is absorbed by work sharing between stations or idle time of downstream stations of the overloaded station.

2 - Multi-product Manufacturing Systems with Arbitrary Processing Times

Ningxuan Kang, Tsinghua University, Department of IE, Shunde Building Room 615, Beijing, 100084, China, kangningxuan@163.com, Li Zheng, Jingshan Li

Multi-product systems with finite buffers and setup times are common. In practice the distribution of processing times is arbitrary, while in existing literature it's assumed to follow an exponential distribution. This paper develops a theoretical method to investigate properties of multi-product systems with non-exponential processing time distributions. An embedded Markov chain model and approximate methods with high accuracy are proposed and tested by numerical experiments and practical data.

3 - Small-volume Parts Must Not Be Forgotten: Affirmative Action in Capacity Planning

Yakov Fradkin, Ford Motor Company, 2101 Village Road, MD 2122, Dearborn, MI, 48121, United States of America, yfradkin@ford.com, Ravi Tappeta, Gint Puskorius

In a typical part volume forecasting process for supplier capacity planning, an automotive OEM begins with forecasts of aggregate characteristics of expected demand, followed by optimization to create a sample of buildable configurations fitting this demand, and concludes with their propagation through the bill of materials to calculate part volumes. We describe a diversity-preserving optimization method that helps to account for even those parts linked to rarely occurring configurations.

4 - Estimation of Active and Passive Maintenance Opportunities in Complex Manufacturing Systems

Xi Gu, Graduate Student, University of Michigan - Ann Arbor, 2300 Hayward St., Ann Arbor, MI, 48109, United States of America, xig@umich.edu, Xiaoning Jin, Jun Ni

Although effective maintenance actions can improve the system availability and product quality, stopping machines for maintenance will take up their production time and may bring system production losses. We discover active and passive maintenance opportunity windows as two types of hidden opportunities for maintenance during production time such that suitable maintenance tasks can be performed without impacts on throughput, and estimate them in complex manufacturing systems in real time.

■ WD66

Mezzanine - 100G

Empirical Analysis of Consumer Behavior on Internet Platforms

Sponsor: Information Systems

Sponsored Session

Chair: Ashish Agarwal, McCombs School of Business, UT-Austin, Austin, TX, 78759, United States of America, ashish.agarwal@mccombs.utexas.edu

1 - The Long Road to Online Conversion: A Model of Multi-channel Attribution

Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 4800 Forbes Avenue, Hamburg Hall, Pittsburgh, PA, 15213, United States of America, vibs@andrew.cmu.edu

A conversion may be the result of a series of ads that were displayed to the consumer across multiple channels. In this paper, we address the problem of attribution using a unique data set from an online campaign. We present a HMM of an individual consumer's behavior based on the concept of a conversion funnel. We observe that different ad formats, affect the consumers differently based on the state they are in. We also present an attribution scheme based on the proposed model.

2 - Tie Strength, Embeddedness and Social Influence: Evidence from a Large Scale Networked Experiment

Dylan Walker, Boston University, School of Management, 595 Commonwealth Ave., Boston, MA, 02215, United States of America, dtwalker@bu.edu, Sinan Aral

Understanding peer influence in networks is critical to estimating product demand and diffusion, creating effective viral marketing, and designing 'network interventions' to promote positive social change. We ran a large-scale randomized field experiment to identify the impact of tie strength and network embeddedness on social influence by randomly manipulating messages sent by adopters of a Facebook application to their 1.3 Million peers.

3 - Social Advertising: Does Social Influence Work ?
Ashish Agarwal, McCombs School of Business, UT Austin, Austin, TX, 78759, United States of America, ashish.agarwal@mccombs.utexas.edu, Kartik Hosanagar

Using data for several ads on Facebook we measure the impact of past connections on the click rate and endorsement rate of ads. We find that increase in the connections does not lead to an increase in the click performance and may even decrease the click performance. Our results inform advertisers on how the social influence impacts the performance of their ads and how should they advertise on social platforms such as Facebook.

■ WD67

Mezzanine - 100H

Portfolio Decision Analysis

Sponsor: Decision Analysis

Sponsored Session

Chair: Janne Kettunen, Assistant Professor, George Washington University, Department of Decision Sciences, 2201 G Street NW, Washington, DC, 20052, United States of America, jkettune@gwu.edu

1 - Optimizer's Curse and Risk in Portfolio Selection
Janne Kettunen, Assistant Professor, George Washington University, Department of Decision Sciences, 2201 G Street NW, Washington, DC, 20052, United States of America, jkettune@gwu.edu, Ahti Salo

When selecting project portfolios using uncertain estimates of project value, projects whose values have been overestimated are more likely to be selected, thus resulting in post-decision disappointment. We examine how this affects the estimated and realized portfolio risk for different correlation structures of project values and estimation errors. Our results can be used to improve the accuracy of risk estimates and the design of project portfolio selection processes in general.

2 - Cost-effectiveness of Task Assignments with an Application to Military Planning
Ahti Salo, Professor, Aalto University, Dept of Mathematics and Systems Analysis, Systems Analysis Laboratory, Aalto, 00076, Finland, ahti.salo@aalto.fi, Jussi Kangaspunta

We consider portfolio problems in which agents are assigned to tasks with the aim of maximizing the total value resulting from the completion of tasks while minimizing the costs arising from these assignments. We determine for a range of cost levels which assignments are cost-effective in the presence of incomplete information about the value of these tasks. We also analyze which agent-task combinations outperform others based on sets of value judgments stated by different groups of experts.

■ WD68

Mezzanine - 100I

Product Variety and Assortment Planning in Retail Operations

Sponsor: Decision Analysis

Sponsored Session

Chair: Arcan Nalca, Queen's School of Business, Queen's University, Kingston, ON, Canada, arcan.nalca@business.queensu.ca

1 - In or Out? Competitive Aspects of Assortment Planning
Victor Martìnez de Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu, H. Sebastian Heese

Retailers use their assortment planning decisions not only to maximize store profits but also to influence supplier competition. We present a model where the retailer can decide how much information can be passed onto the suppliers. We find that it is usually best to pre-announce the assortment breadth but not to declare which suppliers are included, as opposed to requesting bids from all candidates selected in the assortment.

2 - Channel Product Variety with Consumer Evaluation
Ying Xiao, CKGSB, 1 E Changan Ave., Beijing, China, xiaoying@ckgsb.edu.cn, Yunchuan Liu

In this paper, we study the retailer's incentive to manage product variety and the profitabilities of the retailer and manufacturers when consumers do not have full information about the fitting of the brands but can choose to incur a cost to evaluate the products. We show that a manufacturer can benefit when the retailer introduces a competitive brand. We also discuss the motivation of product variety management in a centralized channel compared with a decentralized one.

3 - Supply Chain Contracting in the Presence of Store Brands
Arcan Nalca, Queen's School of Business, Queen's University, Kingston, ON, Canada, arcan.nalca@business.queensu.ca

We consider a supply chain with a retailer and a national brand manufacturer. The retailer sells its store brand in addition to the national brand in an environment where the demand is stochastic and sensitive to the prices of the two products. We investigate the impact of a buy-back and a revenue-sharing contract offered by the manufacturer. Moreover, we identify the profit and assortment implications of these contracts on the manufacturer and the retailer.

■ WD69

Mezzanine - 100J

Behavioral Studies in Supply Chain Management

Contributed Session

Chair: Guido Voigt, Assistant Professor, Otto-von-Guericke University Germany, POB 4120, Magdeburg, Germany, guido.voigt@ovgu.de

1 - Supplier Selection Ethicality: A Behavioral Examination from Social Influence Perspective
Zhongzhi Liu, PhD Candidate, Arizona State University, Department of Supply Chain Management, Main Campus, Tempe, AZ, 85287, United States of America, Zhongzhi.Liu@asu.edu, Thomas Kull

This paper develops a framework to investigate the relationships between external factors (e.g., competition intensity and ethical climate) and committee members' supplier selection ethicality and to study how criteria variety and supplier importance moderate those relationships through informational influence within supplier selection committee. This study will contribute managerial implications for ethical supply chain management and theoretical implications for group behavioral operations.

2 - Decision Behavior in Supply Chains with Random Production Yield
Guido Voigt, Assistant Professor, Otto-von-Guericke University Germany, POB 4120, Magdeburg, Germany, guido.voigt@ovgu.de, Karl Inderfurth, Josephine Clemens

We show that the behavioral effects of demand uncertainty are different from the behavioral effects of supply uncertainty. Supply chains facing supply uncertainty rather exhibit behavior that alternates around the equilibrium than a predictable and systematic bias as shown in newsvendor experiments. We only see a minor behavioral effect of information sharing on yield realizations, indicating that downstream sharing of such information has only a minor effect on supply chain performance.

3 - Experiments on Newsvendor Contracting
Ummuhan Akbay, PhD Student, Sabanci University, Sabanci University, Orhanli Tuzla, Istanbul, 34956, Turkey, ummuhana@sabanciUniversityedu, Murat Kaya

We conduct experiments on a manufacturer-retailer supply chain, where both firms are represented by human subjects. The goal is to understand the factors that affect the manufacturer's contract parameter decisions and retailer's stock quantity decision in this human-to-human strategic interaction. In particular, we study the effects of risk, loss and inequality aversion, learning and retailer's newsvendor heuristics under wholesale, buyback and revenue sharing contracts.

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Xu, Yuqian WD50
Xu, Zhibing SD63, TD63
Xu, Zhiwei SB26
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Xue, Ling SA35
Xue, Weili WB23, WD09
Xue, Yong Qing WC65
Xue, Zhengliang SB23

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Yadav, Prashant SD45, MC36, WA42
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Yang, Zhibin (Ben) MA44, TD44
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Yao, Dong-qing TB52, WA08
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Yao, Ke-Thia SB27
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Yao, Tao SA52, SC54, MC51, TB54, TC54, WA03, WD35
Yarmand, Hamed WC08
Yasar Saglam, Senay MD61
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Ye, Fan TA72, WC07
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Ye, Yinyu MB06, TD07
Ye, Zaojun IS-M
Yeh, Che-Wei WB38
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Yen, John SB65
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Yoo, Onesun SA32, SD13
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Youssef, Mina SC36
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Yu, Qiuping MC47, MD43, WD42
Yu, Sean SA21
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Zhu, Feng TA55, TD54
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Zhu, Zhe (David) MC34
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Zverovich, Victor SB02, TB01, TD08
Zvilichovsky, David TA35
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Sunday, 8:00am - 9:30am

SA01 Modeling Systemic Risk I
SA02 Optimization for Acquisition Decision Support and Trade Analysis
SA03 Stochastic Optimization
SA04 Recent Progress in Mixed Integer Programming
SA05 Network Optimization Under Uncertainty
SA06 Extensions of Second-Order Cone Programming
SA07 Data Driven Methods in Stochastic Programming
SA08 Optimal Learning for Expensive, Complex Functions
SA09 Workforce Analytics
SA10 Fostering the OR/MS Pipeline
SA11 Distributed Approaches
SA12 Entrepreneurship and Social Capital
SA13 Learning Issues in Technology and Innovation Management
SA14 Modeling Risk in Supply Chains
SA15 Meet the Editor of Service Science
SA16 Data-driven Models in Healthcare Applications
SA17 Gaining Business Insights from Big Data Analytics on Federated Data Sources
SA18 Logistics/Capacity Management
SA19 Call Centers I
SA20 Asymptotic Methods in Large-Scale Service Systems
SA21 Resource Allocation in Dynamic Healthcare Settings
SA22 Data Driven Policy Improvements
SA23 Online Stochastic Optimization and Online Advertising
SA24 Analytics and Segmentation for Pricing and Revenue Management
SA25 Auction Theory and Practice
SA26 Location Logistics
SA27 MAS Session I
SA28 Humanitarian Logistics
SA29 Software Demonstrations
SA30 Workforce Optimization in Health Care
SA31 Stochastic Control and Filtering in Finance
SA32 Product Development and Deployment in Entrepreneurial Settings
SA33 Railway Applications Section (RAS) Student Paper Award
SA34 Simulation Optimization
SA35 Economics of Information Systems
SA36 Network Diffusion and Infectious Disease Control
SA37 Contemporary Scheduling
SA38 Deterministic Algorithms for Multiobjective Optimization
SA39 JFIG Paper Competition I
SA40 Transportation Procurement Auctions
SA41 Product Variety and Consumer Choice
SA42 Empirical Research in Operations Management
SA43 Supply Chain Management
SA44 Sourcing, Procurement, and Entry Strategies
SA45 Topics in Sustainable Operations
SA46 Dynamic Programming in Operations Management and Real Options
SA47 Service System Capacity, Control, and Performance: Case Managers, Sales, Call Centers, Scrip Systems
SA48 Behavioral Modeling and Studies in Business
SA49 Correlation Decay Method for Decision, Optimization, and Inference in Large Scale Networks
SA50 Technological Change and Climate Change
SA51 Environmental Tradeoffs in Transportation Decisions
SB29 Software Demonstrations
SA52 Strategic Freight Demand Models
SA53 Container Terminal Logistics
SA54 Advances in V2V and V2I Modeling I: Information
SA55 Evacuation and Emergency Response
SA56 Joint Session ENRE/Climate: Energy, Water, and Climate Policy Modeling
SA57 Uncertainty, Reliability and Maintenance in Energy Systems
SA58 Modeling Human/Natural Resource Interactions
SA59 Environmental Regulations and Operations
SA60 Data Analytics for Decision Making
SA61 Quality and Statistical Decision Making in Health Care Applications
SA62 Sensor-based Process Monitoring and Control
SA63 Data Fusion for Manufacturing Scale-up
SA64 Design for High Reliability, Robustness, and Resilience I
SA65 Social Web Mining
SA66 Economic Behavior in the Lab and in the Field
SA67 Economics of Information and Learning
SA68 Decision Behavior Following Low Probability Events and Near Misses
SA69 Reliability and Real Options in Decision Analysis
SA70 OR Dev from Sabre
SA71 Emerging Aviation Applications
SA72 Topics in OR/MS

Sunday, 11:00am - 12:30pm

SB01 Modeling Systemic Risk II
SB02 Database Structure Design of Stochastic Optimization Based DSS
SB03 Theory of Mixed-Integer Nonlinear Optimization
SB04 Advances in Theory and Computation of Integer Programming
SB05 Game Theory and Discrete Optimization Applications in Matching Markets, Scheduling, E-commerce
SB06 Recent Theoretical and Computational Developments in Interior-point Methods
SB07 Stochastic/Robust Optimization on Energy Applications
SB08 Progressive Hedging for Non-linear and Mixed Integer Problems
SB09 Business Analytics in the Big Data Era
SB10 Case Competition I
SB11 Queuing Models
SB12 Organizational Theory and Organizational Change
SB13 NPD: From Design to Market
SB14 JFIG Paper Competition II
SB15 Empirical Service Science Research
SB16 Personalized Healthcare
SB17 Service Modularization
SB18 Service Delivery
SB19 Service Queues
SB20 Queueing Models
SB21 Health System Design
SB22 Joint Session Healthcare\DM: Microbiome Data: Analyzing the DNA Content of Microbial Communities
SB23 Advances in Revenue Management and Pricing under Consumer Choice Models
SB24 Personalization in Revenue Management
SB25 Algorithmic Mechanism Design
SB26 Energy Issues in Facility Location
SB27 DoD Big Data Analytics: New Applications, Opportunities, and Roadmaps
SB28 Joint Session Doing Good/SPPSN: Doing Good with Good OR I
SB29 Software Demonstrations
SB30 Workforce Flexibility and Productivity
SB31 Modeling and Computation in Financial Engineering
SB32 Entrepreneurship, Innovation and Technology Management
SB33 Railway Application Society: Problem Solving Competition
SB34 Joint Session I-Sim/QSR: Dynamic Data Driven Modeling and Analysis of UAVs and UGVs
SB35 Digital Media
SB36 Joint Session SPPSN/DAS: Community-Based Operations Research
SB37 Recent Trends in Deterministic Scheduling Research
SB38 Recent Advances in Modeling Terrorists' Judgments for Counter-Terrorism Analysis
SB39 Software Demonstrations
SB40 Auctions and Trading Agents
SB41 Achieving Social Responsibility in Supply Chains
SB42 Assortment Planning

SB43 Empirical Research in Operations / SCM
SB44 Cooperation in Firm Network Management
SB45 Sustainable Operations on Electricity and Green Business Models
SB46 Commodities and Operational Decision Making
SB47 Innovation in Service Systems
SB48 Incentives in Sourcing
SB49 Sparse Solutions to Complex Models
SB50 Integrated Assessment Models for Climate Policy Design
SB51 Vehicle Sharing Systems
SB52 Innovative Applications of Routing Problems I
SB53 Facility Logistics I
SB54 Market-based Instruments for Congestion Mitigation: I
SB55 Transit, Pedestrians and Other Alternative Modes in Evacuation
SB56 Stochastic Control and Optimization in Energy Systems
SB57 Uncertainty and Market Equilibria in Energy Markets
SB58 Wildfire Management 1: Forecasting, Detection, and Initial Attack
SB59 Biomass Supply Chain Modeling and Analysis
SB60 2013 INFORMS Data Mining Best Student Paper Competition
SB61 Data Analytics and Modeling for Healthcare Management I
SB62 IIE Transactions Invited Session
SB63 Decision Analysis Approaches and Predictive Modeling to Managing Uncertainty in Manufacturing and Service Systems Design & Operations
SB64 Joint Session QSR/DM: Panel Discussion: Funding Opportunities
SB65 Social Media Analytics and Crisis Informatics
SB66 Information Systems and Operation Management
SB67 Behavioral Economics and Decision Analysis
SB68 What is New in ODQ? (Organizational Decision Quality)
SB69 Sustainable Infrastructure Modeling
SB70 Ticket Pricing and Revenue Management
SB71 Application of OR in Airport Operations
SB72 OR/MS in Economics

Sunday, 1:30pm - 3:00pm

SC01 Portfolio Selection and Measurement of Risk
SC02 Multi-objective Optimization Insights from System Design Problems
SC03 Recent Advances in (MI)NLP
SC04 Selected Topics in Integer Programming
SC05 Network Applications
SC06 Recent Advances in Conic Optimization I
SC07 Joint Session OPT/Climate: Compelling Applications of Decision Simulation
SC08 Allocation and Task Mapping: Parallel Resource Management After a Job is Scheduled to Run
SC09 Big Data Analytics for Cybersecurity
SC10 Case Competition II
SC11 Network Design
SC12 Nicholson Student Paper Competition: Finalists I
SC13 Innovation with Crowds I
SC14 Supply Chain Vulnerability Mitigation
SC15 Models of Co-creation
SC16 Pierskalla Award
SC17 Services Operational Measures and Analytics
SC18 The Social Aspect
SC19 Optimal Control of Queues
SC20 Heavy Tails in Applied Probability
SC21 Optimization Models for Scheduling Problems in Health Care
SC22 Dosage Determination for Complex Toxicological Experiments
SC23 New Approaches to Dynamic Pricing and Demand Estimation
SC24 Big Data Analytics Case Studies in Pricing and Revenue Management
SC25 Ad Auctions
SC26 Location and Transportation
SC27 Joint Session (MAS/HAS/DAS): Decision Making in Military Healthcare
SC28 Joint Session Doing Good/SPPSN: Doing Good with Good OR II
SC29 Software Demonstrations
SC30 Workforce Planning with Learning
SC31 Quantitative Financial Risk Management
SC32 New Product Development
SC33 Capacity Management for Passenger Train Service (RAS Roundtable Part 1)
SC34 Applications of Optimal Learning
SC35 Frontiers of Social Media and Crowdsourcing
SC36 OR in Vaccine Design and Pandemic Preparedness
SC37 Patient Flow: Hospitals and Beyond
SC38 The Role of Human Interactions in MCDM
SC39 Software Demonstrations
SC40 Procurement Auctions and Market Design
SC41 Models in Retail Operations
SC42 The Impact of Government Environmental Regulations on Supply Chains
SC43 Social Interactions and Operations Management I
SC44 Topics in Retailing
SC45 The Role of Regulation on Environmental Sustainability
SC46 Energy and Raw Materials in Production
SC47 Empirical Service Operations
SC48 Best Working Paper Award
SC49 Data-driven Decision-making in Non-stationary Environments
SC50 Sustainable Operations with an Emphasis on Electric Power Industry
SC51 Paratransit Modeling
SC52 Innovative Humanitarian Logistic Formulations
SC53 Facility Logistics - II
SC54 Dynamic Traffic Assignment I - New Modeling Approaches
SC55 Traffic Management in Evacuation
SC56 Modeling, Analysis and Mitigation of Uncertainty and Vulnerability in Power Grids
SC57 Investment Decisions in Energy Systems
SC58 Wildfire Management 2: Efficiency of Pre-suppression and Suppression Activities
SC59 Environmental Energy Models
SC60 Community Detection and Influence Analysis in Social Networks
SC61 Joint Session DM/HAS: Data Mining in Medical Decision Making and Bioinformatics Applications
SC62 Nanomanufacturing and Nanoinformatics I
SC63 Advanced Multivariate Statistical Analysis for Quality and Performance Improvement
SC64 Patient-Centric Healthcare Delivery II
SC65 Methods and Models for Big Network Data
SC66 Topics in Information Systems Research
SC67 Selecting Objectives
SC68 Decision Analysis Applications in the Healthcare Sector
SC69 Stochastic Decision Analysis
SC70 Uncertainty and Aviation Planning
SC71 Delay Propagation in Aviation Networks – Empirical Observations and Models
SC72 Analytics Maturity Model

Sunday, 4:30pm - 6:00pm

SD01 Portfolio Optimization I
SD02 Optimization Software and Applications
SD03 New Methods for MINLP
SD04 Cutting planes in MINLP
SD05 Recent Developments in Solving Network Flow Models and TSP
SD06 Recent Advances in Conic Optimization II
SD07 Multiobjective Probabilistic Programming
SD08 Progressive Hedging for Stochastic Unit Commitment
SD09 Innovative Applications In Analytics: 2013 Winner Reprise
SD10 2013 INFORMS Prize Winner: Ford Motor Company
SD11 Joint Session Telecom/InformEd: NSF TUES Grants in Telecommunications Education

SD12 Nicholson Student Paper Competition: Finalists II
SD13 Process and Product Design Choices in Furthering Innovation
SD14 Assessing Supply Chain Risks and Building Resilience
SD15 Panel Discussion: Complexity in Designing Service
SD16 Measuring Health Outcomes
SD17 Service Science
SD18 Public Service
SD19 Stochastic Systems
SD20 Markov Lecture
SD21 Contemporary Issues in Health Care Performance
SD22 Model-Based Analysis for Healthcare Decision Making
SD23 Pricing and Revenue Management in Pharmaceutical and Healthcare Industry
SD24 Pricing in the Presence of Multiple Customer Types
SD25 Sponsored Search Auctions
SD26 Facility Location and Supply Chain Network Design
SD27 Things We Need: Tailoring Non-DoD Emergent Concepts, Innovation, and Technologies
SD28 Algorithms and Applications
SD29 Software Demonstrations
SD30 Individual Differences in Operations
SD31 Financial Modeling and Computation
SD32 Joint Session TMS/NPD: Meet the Editors
SD33 Passenger Railway Timetabling and Planning (RAS Roundtable Part 2)
SD34 Optimization via Simulation
SD35 Economics of Information Systems
SD36 Models for Emergency Medical Services
SD37 Managing Uncertain Environments in Health Care
SD38 Metaheuristics for Decision-making and Optimization
SD39 Software Demonstrations
SD40 Auctions in Practice
SD41 Social Interactions and Operations Management II
SD42 Supply Chain Operations
SD43 Supply Chain Risk Management
SD44 Empirical Research in Supply Chains
SD45 Sustainable Operations Management with Public Interest
SD46 Global Supply Chain Finance
SD47 Patient Flows: Blocking and Readmissions
SD48 Behavioral Operations in Healthcare
SD49 Modeling Choice
SD50 Electric Power Markets for Managing Variable Solar and Wind Energy
SD51 Public Transit System Routing and Assignment
SD52 Urban and Green Logistics
SD53 Facility Logistics III
SD54 New Modeling Strategies for Transportation Infrastructure
SD55 Resource Location and Management in Emergency Planning and Operations
SD56 Controllability of Renewable Energy Systems
SD57 Analytics in the Petrochemical and Petroleum Industries, Taking a Step Back - Supported by the Petrochemical and Petroleum Subgroup of ENRE
SD58 Applications in Mining
SD59 Ecosystem Conservation and Sustainability
SD60 Data Mining Applications I
SD61 Degradation Modeling under Dynamic Environments and Preventive Maintenance II
SD62 Nanomanufacturing and Nanoinformatics II
SD63 Multivariate Statistical Analysis for Reliability Improvement
SD64 Patient-Centric Healthcare Delivery I
SD65 Complex Systems and Networks
SD66 eBusiness Models, Business Strategy and Innovation
SD67 DAS Practice Award Finalists
SD68 Advances in Decision Analysis: From Multicriteria to Value of Information
SD69 Decision Analysis I: Risk Mitigation
SD70 AAS Dissertation Prize Finalists
SD72 EZ Publish

Monday, 8:00am - 9:30am

MA01 Optimization, Spatial Analysis and GIS I
MA02 Topics in Computational Integer Programming
MA03 Nonconvex Quadratic Programming: Theory and Applications
MA04 MIP Models and Methods
MA05 Stochastic and Probabilistic Network Optimization
MA06 Robust Optimization in Radiation Therapy
MA07 Robust Optimization and Its Applications I
MA08 Computational Linear and Integer Programming I
MA09 Innovative Applications in Analytics Award I
MA10 Panel Discussion: OR, Analytics and the Academic: The Path Forward
MA11 An Interactive Panel/Audience Discussion: Grant Writing for New Faculty
MA12 SpORts - Analysis of Data and Strategies I
MA13 Collaboration in New Product Development
MA14 Supply Chain Risk and Optimization
MA15 Workforce Management I
MA16 Bonder Scholar
MA17 Service Evolution
MA18 Optimization
MA19 Applied Probability Research on Healthcare Applications
MA20 Market and Operations
MA21 Incentives and Risk in Healthcare Systems and Markets – An Optimization Approach
MA22 Applications of Analytics to Patient Management
MA23 New Directions in Pricing and Revenue Management
MA24 Computational Methods for Revenue Management
MA25 Spectrum Market Design
MA26 Location Models in Natural Disaster Applications
MA27 Military Applications Research at RAND
MA28 Theory and International Applications I
MA29 Software Demonstrations
MA30 Workforce Teams/Groups and Performance
MA31 Government Policies and Financial Markets
MA32 Novel Research in Technology Management
MA33 Business Analytics in Railroads
MA34 Simulation Output Analysis
MA35 Technology Based Services in Retailing
MA36 Efficient Utilization of Public Services and Programs for Improving Public Health
MA37 Supply Chain Scheduling and Optimization
MA38 Applications of Multiple Criteria Decision Making
MA39 Daniel H. Wagner Prize I
MA41 New Topics in Operations Management
MA42 Empirical Healthcare Operations Management
MA43 Practice-Based Research in Humanitarian Operations
MA44 Bargaining and Information
MA45 Advances in Stochastic Models for Chronic Disease Screening and Treatment
MA46 Inventory Financing
MA47 Managing Customer Service Systems
MA48 Contracts and Non-Monetary Motivations in Behavioral Operations
MA49 Advances in Risk-Averse Optimization
MA50 Impacts of Climate Change on the Automotive Industry
MA51 Flexible Multimodal Transport Systems
MA52 Scheduling Problems in Transportation Systems
MA54 Advances in V2V and V2I Modeling II: Applications
MA55 Disaster Preparedness and Management
MA56 Applications of Parallel Computing in Energy Systems Planning and Operations (Part I)
MA57 Energy Market Models I
MA58 Forestry Supply Chains and Industrial Management
MA59 Models for Public Charging Infrastructure System of Plug-in Electric Vehicles
MA60 Data Analytics and Modeling for Healthcare Management II

MA61 Data Mining Topics I
MA62 2013 QSR Best Student Paper Competition
MA63 Degradation Modeling under Dynamic Environments and Preventive Maintenance I
MA64 Maintenance Optimization
MA65 Business Process Intelligence
MA66 Social Media and Business Applications
MA67 Game Theory, Decision Analysis, and Homeland Security
MA68 Teaching and Evaluating Decision-Making Competence
MA69 Decision Analysis III: Strategic Decision Making under Risk
MA70 Airline Revenue Management in the New World of Customer Choice and Merchandising
MA71 Air Transportation and the Environment
MA72 Credit, Liquidity, and Systemic Risk

Monday, 11:00am - 12:30pm

MB01 Optimization, Spatial Analysis and GIS 2
MB02 Scheduling and Logistics
MB03 Combinatorial Methods in Global Optimization
MB04 Integer Programming and Cutting Planes
MB05 Interdiction Models in Complex Networks
MB06 Linear Programming Approaches to Dynamic Programming
MB07 Robust Design
MB08 Computational Linear and Integer Programming II
MB09 Innovative Applications in Analytics Award II
MB10 Joint Session CPMS/TSL/JFIG: A Panel Discussion on Academic-Industry Collaboration
MB11 In Honor of Saul Gass I
MB12 SpORts - Analysis of Data and Strategies II
MB13 Environmentally Sustainable Product Design
MB14 Unauthorized Channels and Counterfeit Products
MB15 Workforce Management II
MB16 Decision Making in Health Care: Modeling, Analysis, and Applications
MB17 Service Productivity
MB18 Real Options/EDA
MB19 Advances in Applied Probability and Monte Carlo Methods
MB20 Dynamic Control & Real Options Applications
MB21 Optimization Models in Disease Prevention and Treatment
MB22 Decision Making Tools with Limited Information
MB23 Revenue Management & Pricing: Modeling and Empirical Perspectives
MB24 Modeling Demand in Revenue Management
MB25 Bidder Behavior in the Lab and in the Field
MB26 Urban Operations Research
MB27 MAS Session II
MB28 Estimators
MB29 Software Demonstrations
MB31 Best of Women in OR/MS: Papers in Top OR Journals Presented by Their Women Authors
MB32 Emerging Scholars in Technology Management
MB33 Railroad Predictive Analytics
MB34 Simulation Society and QSR Joint Session
MB35 Economics of Online Platforms
MB36 OR Models for Disease Management and Public Health Policy
MB37 Scheduling and Applications
MB38 New Applications of Multi-Criteria Decision Analysis
MB39 Daniel H. Wagner Prize II
MB40 Panel: Overarching OR as a Catalyst for Grand Challenges
MB41 Financial Flows and Supply Chain Performance
MB42 Economics of Innovation
MB43 Retail Operations
MB44 Academic Job Search Panel
MB45 Challenging Decisions in Pharmaceutical Supply Chains
MB46 Managing Inventory under Financial Constraints
MB47 Service Operations
MB48 Demand Forecasting and Managerial Behavior
MB49 Mixed-Integer Second-Order Cone Programming: A Survey
MB50 Climate Change and OR Applications
MB51 Urban Traffic Modeling under Uncertainty
MB52 Sustainabie Urban Freight Systems/City Logistics
MB53 Freight Transportation Logistics
MB54 Market-based Instruments for Congestion Mitigation: II
MB55 Hazmat Transport
MB56 Interpretable Machine Learning
MB57 New Frontiers in Optimal Power Flow Computation
MB58 Strategic Harvest Planning
MB59 Sustainable and Responsible Supply Chain Management
MB60 Theoretical Data Mining I
MB61 Data Mining Applications III
MB62 Data Fusion in Healthcare Applications I
MB63 Advanced Reliability Testing Models and Testing Plans
MB64 Design for High Reliability, Robustness, and Resilience II
MB65 Social Media and Group Activities
MB66 Healthcare and Service Management
MB67 Panel Discussion: Teaching Decision Analysis
MB68 Graphical Models in Decision Analysis
MB69 Decision Analysis II: Optimizing Strategic Decisions
MB70 Joint Session AAS/TSL: Service Level Expectation Setting for Air Traffic Management
MB71 Aviation Applications
MB72 Stochastic Control in Mathematical Finance

Monday, 12:30pm - 2:30pm
Interactive Session

Monday, 1:30pm - 3:00pm

MC01 Optimization, Spatial Analysis and GIS 3
MC02 IOS Awardee Presentations
MC03 Global Optimization in Graphs/Networks
MC04 Robust Optimization and Approximation
MC05 Clique Relaxation Models in Networks
MC06 Multiobjective Optimization Applied in the Industry through the use of Metaheuristics
MC07 Information Theory and Optimization
MC08 Modeling Systems I
MC09 Innovative Applications in Analytics Award III
MC10 CAP and Continuing Educations
MC11 Optimization Models Deployed as Web-based Applications and on Mobile Platforms
MC12 SpORts - Comparing Sports Performances and Records
MC13 Exploring Key Drivers of Innovation at the Level of the Individual, the Organization, and the Crowd
MC14 Supply Chain Reliability and Robustness: Models and Methodologies
MC15 Case Studies and Methods in Disaster Relief
MC16 Tutorial: Engineering for Efficient, Effective, Equitable Decisions in Public Health
MC17 Customer Satisfaction
MC18 Service Sourcing
MC19 Healthcare Applications
MC20 Control of Queueing Systems
MC21 Analytical Approaches for Improving Healthcare Operations
MC22 George B. Dantzig Dissertation Prize I
MC23 Practical Aspects of Revenue Management and Pricing
MC24 Retail Operations
MC25 Strategy-Proofness
MC26 Location Problems under Uncertainty
MC27 Operations Research and Mathematical Modeling in Military Decision Making
MC28 Theory and International Applications II
MC29 Software Demonstrations
MC30 Industrial Applications for Optimization Methodologies
MC31 Careers in Industry
MC32 Innovation in Product, Service and Process Systems
MC33 National University Rail Center (NURail) Systems Research
MC34 Financial Services Section Student Paper Competition
MC35 eServices

MC36 Joint Session SPPSN/HAS: Global Health Supply Chains
MC37 Supply Chain Scheduling in Industry and Terminal Operations
MC38 Multi-objective Optimization and Applications
MC39 Daniel H. Wagner Prize III
MC41 Customer Oriented Operations Models
MC42 Sustainable Operations
MC43 Capacity Management and Information
MC44 Industry Job Search Panel
MC45 Topics in Aviation Contracts
MC46 Operations and Finance Interface
MC47 Empirical Research in Service Operations
MC48 INFORMS Connect: Networking, Online Collaboration, & Communities
MC49 Optimal Placement in a Limit Order Book
MC50 Energy I: Nonrenewable Resources and Power Generation
MC51 Network Design and Routing with Robust Concerns and Operational Choice
MC52 Logistics & Supply Chain Management: Industry Applications
MC53 Facility Logistics -IV
MC54 Dynamic Traffic Assignment II - Applications
MC55 Disaster Preparedness and Emergency Planning
MC56 Applications of Parallel Computing in Energy Systems Planning and Operations (Part II)
MC57 Energy Market Models II
MC58 Real Options
MC59 Biofuel Supply Chain Design and Environmental Analysis
MC60 Theoretical Data Mining II
MC61 Data Mining Topics II
MC62 Technometrics Invited Session: Big & Complex Data Problems
MC63 From Data to Decision-Making: A SPC Perspective
MC64 Multivariate Data Analysis for Quality and Reliability Improvement II
MC65 Visions of Social Media Deep Analytics: Beyond Today's Challenges
MC66 Pricing and Contracting in Digital Economy
MC67 Utility Theory: Advances and Applications
MC68 Combining Point and Interval Forecasts
MC69 Decision Analysis IV: Behavioral Factors
MC70 Airport/Airline Operations Management
MC71 Aviation Safety Management System (SMS): Modeling and Applications
MC72 Risk Management and Quantitative Finance

Monday, 4:30pm - 6:00pm

MD02 Topics in Approximate Dynamic Programming
MD03 Reformulations and Convex Underestimators in Global Optimization
MD04 Mixed-Integer Programming: Cutting Planes and Models
MD05 Survivable Network Design and Its Applications
MD06 Network Optimization
MD07 Learning and Computation for Stochastic Optimization and Variational Problems
MD08 Modeling Systems II
MD09 Challenges and Opportunities in Healthcare Analytics
MD10 Panel Session: Managing Successful Careers in O.R. Practice – A Panel Discussion
MD11 Panel Session: 10 Habits of a Successful Assistant Professor
MD12 SpORts - Scheduling and Alignment
MD13 Innovation with Crowds II
MD14 Supply Chain: Disruption Management
MD15 Retail Operations
MD16 Improved Cancer Diagnosis and Treatment Through Operations Research
MD17 E-Commerce
MD18 Knowledge Management
MD19 Call Centers II
MD20 Advances in Stochastic Systems
MD21 Joint Session HAS\SPPSN: Healthcare Decisions in Resource Constrained Environments
MD22 International Journal of Operations Research (IJOR) and Journal of Industrial and Production Engineering (JIPE)
MD23 Topics in Revenue Management and Pricing
MD24 New Directions in Revenue Management
MD25 Electricity Markets
MD26 Supply Chain Design Under Disruptions
MD27 Things We'll Share: Developing Awareness and Sponsorship for Inter-service
MD28 Multiple Perspectives
MD29 Software Demonstrations
MD30 Optimization Methodologies
MD31 Spreadsheet Applications and Examples
MD32 TMS Distinguished Speaker
MD33 OR Applications in Homeland Security
MD34 In Honor of Saul Gass II
MD35 Social Media and Electronic Business
MD36 Transportation and Routing in Public Policy
MD37 Optimization and Mechanism Design
MD38 Evolutionary Multi-Objective Optimization
MD39 Joint Session TSL/RAS: Rail Systems Management and Maintenance
MD40 Panel Discussion: OR for Science and Engineering Grand Challenges
MD41 Socially-Responsible Operations Management
MD42 Operational Decisions under Uncertainty
MD43 Operations Economics
MD44 Topics in Supply Chain Responsibility
MD45 Sustainable Supply Chains
MD46 Managing Supply and Quality Risks
MD47 Design and Control of Service Operations
MD48 Certified Analytics Professional Program (CAP)
MD49 Network Search from a Game Theoretic Viewpoint
MD50 Energy II: Renewable Energy Generation
MD51 Pedestrian and Bicycle Transportation Systems
MD52 Stochastic Network Design
MD53 Freight Logistics I
MD54 Real-Time Traffic Monitoring and Control
MD55 Network Design and Emergencies
MD56 Optimization and Scheduling in Petroleum and Petrochemical Industries - Supported by the Petrochemical and Petroleum Subgroup of ENRE
MD57 Renewable Energy and Biofuel Supply Chain
MD58 Demand Response and Load Aggregation in Electricity Markets
MD59 Integrating Sustainability into Operational Decisions
MD60 Joint DM/ICS: Statistical Modeling in Complex Optimization Problems
MD61 Classifier Ensembles Generation Methods
MD62 Reliability and Quality in Emerging Technology and Systems
MD63 Nanomaterial Process Modeling and Analysis
MD64 Decision Support Systems
MD65 Virtual Communities and Collective Action
MD66 Economics of Information Systems
MD67 Decision Analysis Society Awards
MD68 Flexible Decision Making
MD69 Topics in Decision Analysis
MD70 Joint Session AAS/TSL: Trajectory Control Models for Improving National Airspace System Performance
MD71 Aviation Delay Modelling and Impact Assessment
MD72 Time Consistent Control in Portfolio Selection/ Risk Management

Tuesday, 8:00am - 9:30am

TA01 Optimal Execution and Market Microstructure
TA02 Emerging Applications of Large-Scale Nonlinear Optimization
TA03 Recent Advances in Global Optimization I
TA04 Stochastic Mixed-Integer Programming
TA05 Integer Programming and Networks
TA06 Network Optimization II
TA07 Stochastic Programming Approaches to Service System Staffing and Scheduling Problems
TA08 Modeling Tools for Economic Equilibrium Analysis
TA09 Quantitative Methods in Analytics
TA10 Outsourcing and/or Offshoring Analytics
TA11 Adherence and Decrement, The Keys to Managing Chronic Disease
TA12 SpORts - Networks
TA13 Innovation and New Product Development in Emerging Contexts
TA14 Journal of Systems Science and Systems Engineering
TA15 Best Student Paper Award - Finalist
TA16 Applications of Stochastic Optimization in Healthcare
TA17 Service System
TA18 Recommendation
TA19 Capacity Optimization in Queueing Systems
TA20 Robust Stochastic Optimization
TA21 Rural Health Care
TA22 Descriptive and Prescriptive Models for Epidemic Growth using SIR Models
TA23 Theory and Practice in Retail
TA24 Solution Methods for RM and Pricing
TA25 Allocation and Market Design
TA26 Location Models I
TA27 Raytheon Innovations in Military Operations Analysis
TA28 Innovative Applications
TA29 Software Demonstrations
TA30 Combinatorial Optimization
TA31 Financial Regulation and Risk Management
TA32 Managing Technological Innovation: Exploring Multiple Perspectives
TA33 Military Asset Planning and Assessment
TA34 Efficient Learning in Stochastic Optimization
TA35 Economy of the Crowd
TA36 Public Services and Operations Research
TA37 Airport Operations Management
TA38 Building MCDM Models: Practical and Methodological Issues
TA39 Joint Session RAS/TSL: Railroad OR Models
TA41 Models of Consumer Behavior
TA42 Sustainable Operations Management
TA43 Information and Operations Management
TA44 Supply Chain Management and Innovation
TA45 Capacity Management and Scheduling in Hospitals
TA46 Operations and Finance Interface
TA47 Service Design: Work Allocation, Task Sequencing, and Pricing
TA48 Opportunities in Behavioral Operations: Different Perspectives
TA49 Performance Variability in Mixed-integer Programming
TA50 Energy III: Management of Power Systems
TA51 Transportation Planning under Uncertainty
TA52 Revenue Management in Transportation
TA53 Agricultural Supply Chain
TA54 Panel Discussion: How to Make Professional Presentations?
TA55 Traffic Assignment and Applications
TA56 Introducing Renewables and Demand Side into Complex Power System Models
TA57 Energy Modeling
TA58 Algorithms for the Smart Grid
TA59 New Methods in Sustainable Production and Transportation
TA60 Data Mining Applications II
TA61 Data Mining in Medical and Business Domain
TA62 Image and Functional Data Analysis; Methods and Applications I
TA63 Condition-based Maintenance Optimization
TA64 Decision-Making & E-Retailing
TA65 Miscellaneous Networks Analyzed
TA66 IT Governance, Distribution and Licensing
TA67 Decision Making in Interdependent Systems
TA68 Operations and Supply Chain Management
TA69 Marketing I: Interaction Quality and Relationship
TA70 Supply Chain and Logistics
TA71 Air Systems Performance
TA72 Recent Advance in Stochastic Optimal Control

Tuesday, 11:00am - 12:30pm

TB01 Portfolio Optimization II
TB02 Nonlinear Optimization Algorithms
TB03 Advances on Global Optimization and MINLP Algorithms
TB04 Joint Session OPT IP/OPT Global: Bilevel and Multilevel Optimization: Algorithms and Applications
TB05 Optimization in Energy Networks
TB06 Humanitarian Logistics and Disaster Response
TB07 Robust Optimization and Its Applications II
TB08 Constraint Programming I
TB09 Dynamic Pricing/Inventory Control
TB10 Risk Models and Optimization in Supply Chains
TB11 Spotlight on CAREER Award Winning Research
TB12 KINFORMS
TB13 New Product Development I: Technology Selection and Innovation
TB14 Location Models IV
TB15 Best Paper Award - Competitive Presentations I
TB16 Stochastic Operations Research in Healthcare
TB17 Service Co-Production
TB18 Healthcare
TB19 Stochastic Models and Applications - I
TB20 Revenue Management in Retail
TB21 Capacity Planning and Scheduling for the Care of the Elderly
TB22 Joint Session Disease Pro/DM: Proteomic and Genomic Analysis of Human Diseases
TB23 Dynamic Pricing and Assortment Optimization with Limited Information
TB24 Topics in Dynamic Pricing and Mechanism Design
TB25 Modeling Economic Markets
TB26 Competitive Facility Location
TB27 Military Operations Research using Social Science Methodologies
TB28 Optimization Issues in Cloud Computing
TB29 Software Demonstrations
TB30 Continuous Optimization
TB31 Analytic Methods in Quantitative Finance
TB32 Technology Management Section Best Paper Winner Presentation
TB33 Risk and Uncertainty in Homeland Security
TB34 Advances in Optimization via Simulation
TB35 Energy Information Systems
TB36 Planning for Health and Humanitarian Response
TB37 Managing Complex Projects
TB38 Multicriteria Optimization and Decision Making
TB39 Train Timetabling, Train Routing, and Railway Capacity Analysis
TB40 TSL Dissertation/Thesis Award Winners
TB41 Product Design and Strategy: Social and Supply Chain Considerations
TB42 Global Supply Chain
TB43 Risk Driven Optimization of Supply Chain and Logistics Systems
TB44 Rational Consumer Behavior and Operational Decision-making
TB45 Design of Healthcare Appointment Systems
TB46 Supply Chain Risk Management
TB47 Empirical Study of Efficiency and Productivity in Services: A Cross-Industry Perspective

TB48 B2B Pricing
TB49 Market Microstructure and High-Frequency Trading
TB50 Energy IV: Renewable Energy and Environment
TB51 Transit Modeling
TB52 Transport, Trade and Logistics
TB53 Advances in Vehicle Problems I
TB54 Dynamic Traffic Assignment III -Data Issues
TB55 Traffic Modeling and State Estimation using Emerging Data Sources
TB56 Operations and Planning with Energy Storage
TB57 Transmission Topology Control and Optimization
TB58 Risk Management in Electricity Markets
TB59 Sustainable Natural Resource Management with Environmental Concerns
TB60 Mathematical Optimization in Data Mining
TB61 Data-driven Simulation Modeling
TB62 Image and Functional Data Analysis: Methods and Applications II
TB63 The Modeling, Monitoring and Control of Systems using Complex Data (I)
TB64 Contemporary Topics of Information Systems in the New Millennium
TB65 Understanding through Social Media
TB66 Theory and Application of Crowdsourcing
TB67 Healthcare Applications in OR/MS I
TB68 Validating Models of Adversary Behavior
TB69 Marketing II: Customer Characteristics and Marketing Strategies
TB70 Performance and Optimization in Surface Operations Management
TB71 Advances in Game Theory
TB72 Financial Network and Systemic Risk

Tuesday, 12:30pm - 2:30pm
Interactive Session

Tuesday, 1:30pm - 3:00pm

TC01 Quantitative Methods in Finance
TC02 Methods For Nonlinear Optimization
TC03 Multilevel Optimization
TC04 Algorithms and Cutting Planes for Optimization under Uncertainty
TC05 Stochastic Integer Programming Methods and Applications
TC06 Social Network Analysis I
TC07 Analysis and Optimization of Stochastic Systems via Robust Optimization
TC08 Constraint Programming II
TC09 Risk-Averse Decision Models
TC10 Creative Techniques for OR/MS Education
TC11 Panel Session with the Clinton Health Access Initiative
TC13 New Product Development II: Testing, Adoption, and Optimization
TC14 Acta Automatica Sinica - Parallel Control and Management
TC15 Best Paper Award - Competitive Presentations II
TC16 Health Care Operations Management
TC17 IT-Service
TC18 Service Applications
TC19 Network Science and Random Graphs
TC20 Learning and Consumer Behavior in Revenue Management
TC21 Disease Models and Economic Evaluation
TC22 Disease Modeling and Decision Support for Healthcare Delivery
TC23 New Choice Models and Applications
TC24 Dynamic Pricing and Revenue Management
TC25 Problems and Models for Repeated Auctions
TC26 Location Models II
TC27 Inventory Management: Procurement and Purchasing
TC28 Strategic Behavior in Large Scale Systems
TC29 Software Demonstrations
TC30 Convex Optimization
TC31 Methods in Financial Risk Management
TC32 Outsourcing and Offshoring Innovation
TC33 OR Modeling of Decentralized UAV Routing Problems
TC34 Simulation-based Optimization
TC35 Social Influence in Online Environments
TC36 Public-Sector Decision Modeling Applications
TC37 Robust Project Scheduling
TC38 Supply Chain: Inventory Management
TC39 Joint Session RAS/TSL: High-Speed Rail Capacity Analysis
TC40 Transit System Modeling II: Routing
TC41 Joint Session MSOM/BOM: Behavioral Operations
TC42 Supply Management and Operations/Financial Decisions
TC43 Issues in Service and Supply Chain Operations
TC44 Models with Customer Choice
TC45 Appointment Scheduling Under Patient Preferences
TC46 Supply Chain Management with Tax and Financial Planning
TC47 Performance Evaluation and Improved Control for Service Systems
TC48 Fairness, and Cultural Issues in Operations Environments
TC49 Simulation Optimization: A Concise Overview and Implementation Guide
TC50 Energy V: Power Generation and Distribution under Uncertainty
TC51 Transit System Modeling I: Scheduling
TC52 Innovative Applications of Routing Problems II
TC53 Advances in Vehicle Routing Problems II
TC54 Market-based Instruments for Congestion Mitigation: III
TC55 Shift Scheduling
TC56 Optimization Methods in Smart Grid
TC57 Optimizing EV Charging and Investment in Generation Capacity and CCS
TC58 Mediating Risk with Financial Products in Electricity Markets
TC59 Green Behavior and Environmental Sustainability
TC60 Joint Session DM/HAS/AI: System Modeling and Health Informatics
TC61 Data Mining in Health Applications
TC62 Data Fusion for Process Control
TC63 The Modeling, Monitoring and Control of Systems using Complex Data (II)
TC64 Health Information Technology
TC65 Determining Sentiment or Importance within Social Media
TC66 Business Analytics for Social Media
TC67 Aggregation of Expert Judgments
TC68 Decision Analytics in Finance
TC69 Retail Management I
TC70 Joint Session AAS/TSL: Predictability in the National Airspace System
TC71 Game Theory Applications I
TC72 Systemic and Liquidity Risk

Tuesday, 4:30pm - 6:00pm

TD01 Energy Markets
TD02 Algorithms and Applications of Large Scale Optimization
TD03 Recent Advances in Deterministic Global Optimization
TD04 Advances in Integer Programming
TD05 Stochastic Programming of Nonlinear Processes
TD06 Social Network Analysis II
TD07 Data-driven Optimization
TD08 Constraint Programming III
TD09 Supply Chain Analytics
TD10 Joint Session INFORMEd/Analytics: Teaching Business Analytics: Best Practices I
TD11 Joint Session WORMS/JFIG/MIF: Speed Networking
TD12 Stochastic Optimization with Applications in Power System Operations
TD13 New Product Development III: Customer Interaction

TD14 OR Practice in Supply Chain Management
TD15 Best Paper Award - Competitive Presentations III
TD16 Optimization Models and Techniques in Radiation Treatment Planning
TD17 Human Resources
TD18 Solid Organ Transplant Operations
TD19 Stochastic Models and Applications - II
TD20 Pricing Strategy and Models for Storable and Nonstorable Commodities
TD21 Clinical Decision Making
TD22 Health Care I: Screening
TD23 Assortment and Price Optimization
TD24 Demand Uncertainty and Pricing in Freight Transportation
TD25 Mechanism Design
TD26 Location Models III
TD27 Inventory Management: Production and Scheduling
TD28 Advances in Cloud Computing
TD29 Software Demonstrations
TD30 Optimization with Metaheuristics
TD31 Advances in Financial Engineering
TD32 Models of Innovation Management
TD33 Regulating Hazardous Materials Transportation
TD34 Agent-based Modeling and Simulation – Overview and Tutorial
TD35 Advertising and Commerce in the New Mobile Economy
TD36 Health Care XI: Effective Therapy and Treatment
TD37 Periodic Scheduling and Applications
TD38 Supply Chain: Operations Management
TD39 Railway Service Planning and New Technology
TD40 (Process) Flexibility in Manufacturing and Computer Systems
TD41 Managing Strategic Behavior In Service Systems
TD42 Collaboration and Competition in Supply Chains
TD43 Analytics for Non-profit Organizations
TD44 Supply and Distribution Risk Management
TD45 Investigations of Tradeoffs in Healthcare Operations: Flexibility, Efficiency, and Clinical Quality
TD46 Sustainability and Environmental Operations
TD47 Queuing Games and Pricing
TD48 Behavioral Issues in Forecasting and Inventory Management
TD49 Stochastic Variational Inequality Problems: Applications, Analysis, and Algorithms
TD50 Energy VI: Power Generation with Demand Consideration
TD51 New Traffic Signal Control Schemes
TD52 Freight Logistics II
TD53 Vehicle Routing Applications
TD54 Innovative Modeling and Data Sources for Intersections
TD55 Scheduling I
TD56 Integrating Renewables and Security Constraints
TD57 Generation Investment: Hierarchical Models and Equilibria
TD58 Modeling in Energy Markets and Systems
TD59 Climate Change and Policy
TD60 Kernel Methods in Data Analytics
TD61 Transportation Constraints in Biofuel Supply Chain Infrastructure Systems
TD62 Prediction of Non-stationary Process
TD63 Multivariate Data Analysis for Quality and Reliability Improvement I
TD64 Energy Information Systems
TD65 Models of Information Diffusion in Social Networks
TD66 Two-sided Market
TD67 Joint Session DAS/BOM:Decision Analysis and Behavioral Operations
TD68 Topics in Decision Analysis
TD69 Retail Management II
TD70 Aviation Applications Section: Keynote Presentation
TD71 Game Theory Applications II
TD72 Forecasting

Wednesday, 8:00am - 9:30am

WA01 Portfolio Optimization III
WA02 Nonlinear Optimization and Its Application
WA03 Joint Session OPT Global/ICS: Global and Nonlinear Optimization
WA04 Theory of Mixed Integer Programming
WA05 Approximate Dynamic Programming
WA06 Network Analysis
WA07 Stochastic Programming in Financial Portfolio Management
WA08 Computational Optimization
WA09 Topics in Analytics
WA10 Joint InformEd/Analytics: Panel Discussion: Teaching Data Mining
WA11 Social Networks in Operations Management and Marketing
WA12 Financial Markets: Monitoring and Assessment
WA13 Disaster and Emergency Management: Models
WA14 Supply Chain: Risk Managment
WA15 Designing and Managing Service Systems
WA16 Healthcare Systems Operations and Management
WA17 Service Contract
WA18 Advances in Queueing Models I
WA19 Matching Markets I
WA20 Pricing in Supply Chains
WA21 Healthcare Innovations
WA22 Health Care II: Data Analysis
WA23 Pricing under Retail Competition with Multiple Products
WA24 Demand Control Strategies (Planning and Pricing) in Revenue Management II
WA27 Inventory Management: Decision Support
WA28 Applied Probability
WA29 Software Demonstrations
WC30 Integer Programming Applications I
WA31 Computational Methods for Financial Engineering
WA32 Entrepreneurship: Theory and Action
WA34 Joint Session I-Sim/HS: Managing Healthcare Resources using Simulation
WA35 Theory of Network Optimization
WA36 Health Care VII: Public Health, Quantitative Approaches
WA37 Planning and Scheduling Issues in Service and Manufacturing Systems
WA38 Topics in Supply Chain Management I
WA41 Empirical research in OM/Marketing Interface
WA42 Empirical Research in Healthcare
WA43 Advances in Behavioral Operations Management
WA44 Supply Chain: Optimization I
WA45 Factors in Hospital Productivity
WA46 Environmental Considerations in Business Operations-I
WA47 Operations Management I: Contracting Arrangements
WA48 Behavioral Issues in OM
WA49 Efficiency Concepts in MCDM, DEA, and Finance
WA50 Remanufacturing
WA51 Information and Route Choice
WA52 Online Traveling Salesman Problems, and Variants
WA53 Freight Transportation
WA54 Real-Time Resource Management in Transportation
WA55 Scheduling II
WA56 OR and Energy Development
WA57 Smart Grid Integration and Analysis in the New Electrical Era
WA58 Commitment, Competition, and Pricing in Power Markets
WA59 Climate Change Mitigation and Power Generation
WA60 Joint Session DM/HAS: Statistical Learning and OR in Health Application
WA61 Data Mining I
WA62 Joint Session QSR/ENRE: Reliability and Prediction in Renewable Power Systems
WA63 Bayesian Methods for Industrial Statistics co-sponsored with ISBA/Industrial Statistics Section
WA64 Reliability: Maintenance and Warranty
WA65 Transit Operations

WA66 Networks, Analytics and Beyond
WA67 Abduction and Perceptions
WA68 Organizational Change and Decision Making under Uncertainty
WA69 Auctions and Mechanism Design I

Wednesday, 11:00am - 12:30pm

WB01 Optimization Methods for Portfolio Selection and Trade Execution
WB02 Reduced-order Methods for Nonlinear and Stochastic Optimization
WB03 Recent Progress in the Theory of Integer Programming
WB04 At the Intersection of Convex Optimization and Integer Programming
WB05 Stochastic Optimization I
WB06 Evacuation and Location Problems on Networks
WB07 Stochastic Programming Models for Biomass Supply Systems
WB08 Methods and Implementations for the Computationally Challenging Supply Chain Management
WB09 Marketing Analytics
WB10 Joint Session InformEd/Analytics: Teaching Business Analytics: Best Practices 2
WB11 Demand-driven Marketing
WB12 Portfolio Analysis
WB13 Disaster and Emergency Management: Practices
WB14 Supply Chain: Shipping and Transportation
WB15 Servicization: Integrated Product-Service Strategies
WB16 Approximate Dynamic Programming in Health Care
WB17 New Service Development
WB18 Advances in Queueing Models II
WB19 Stochastic Models and Applications - III
WB20 Strategic Dynamic Pricing and Revenue Management
WB21 Optimization in Radiation Therapy Treatment Planning
WB22 Health Care III: Scheduling I
WB23 Topics in Retail
WB24 Issues in Assortment Retailing
WB26 GIS and Spatial Analysis
WB27 Inventory Management: Retail and Delivery
WB28 Simulation
WB29 Firm Performance and Valuation
WB30 Heuristic Optimization Applications
WB31 Quantitative Financial Risk Management
WB32 Emergent Innovation and Value Creation in Product – Service Systems (PSS)
WB34 Overcoming the Challenge of Input Uncertainty
WB35 Applications of Network Optimization
WB36 Health Care VIII: Inventory and Supply Chain
WB37 Project Management
WB38 Topics in Supply Chain Management II
WB41 Supply Chain Networks
WB42 Collaborative Processes in Supply Chains and Services
WB43 Topics in Supply Chain Management
WB44 Supply Chain: Optimization II
WB45 Organizational Learning and Healthcare Performance
WB46 Environmental Considerations in Business Operations-II
WB47 Operations Management II: Stochastic Optimization in OM
WB48 Consumer Behavior and Service Operations Management
WB49 Superquantiles and Their Applications to Risk, Random Variables, and Regression
WB50 Analytics-based Business Applications
WB51 Queuing Network Applications
WB52 Innovative Applications of Routing Problems III
WB53 Transportation Network Design
WB54 Recent Advances for Modeling Day to Day Traffic Assignment
WB55 Production Scheduling
WB56 Energy Efficiency and Demand Response Modeling
WB57 Modeling and Analysis on Energy Systems
WB59 Agriculture and Natural Resources Management
WB60 Joint Session DM/HAS/AI: Simulation Modeling in Health Care
WB61 CS and OR Interface
WB62 Industrial Data Analytics
WB63 Condition Monitoring and Prognostics
WB64 Reliability: System Analysis
WB65 Traffic Operations
WB66 Supply Chain Information Systems
WB68 Healthcare Applications in OR/MS II
WB69 Auctions and Mechanism Design II

Wednesday, 1:30pm - 3:00pm

WC01 Optimization and Computation in Financial Engineering
WC02 Theoretical Nonlinear Optimization
WC03 Extended Formulations
WC04 Optimization for Electric Energy Systems
WC05 Nonlinear Risk-averse Stochastic Programming
WC06 Data-driven Network Models
WC07 Simulation and Optimization of Stochastic Decision Processes
WC08 Computation in Healthcare
WC09 Improving Security via Analytics
WC11 Pricing, Inventory and Sales Management
WC12 Financial Risk and Operations Management
WC13 Homeland Security
WC14 Reverse Supply Chain Management
WC16 Management of Blood Products
WC17 Green Science
WC18 Dynamic Programming Applications
WC19 Matching Markets II
WC20 Revenue Management in Hospitality and Entertainment
WC21 Models and Analyses: Applications in Healthcare Engineering
WC22 Health Care IV: Scheduling II
WC23 Demand Control Strategies (Dynamic Pricing) in Revenue Management I
WC24 Dynamic Pricing and Network Games
WC26 Facilities Planning I
WC27 Inventory Management: Risk Management
WC28 Simulation and Optimization
WC29 Technology Management
WC31 Portfolio Optimization and Healthcare Finance
WC30 Integer Programming Applications I
WC32 Miscellaneous Topics in Technology Management
WC34 Topics in Simulation Modeling and Analysis
WC35 Robust Optimization I
WC36 Health Care IX: Economic Efficiency
WC37 Integrated Production Scheduling
WC38 Supply Chain Management I
WC41 Data-driven Approaches in Operations
WC42 Pricing and Revenue Management
WC43 Stochastic Optimization II
WC44 Supply Chain: Optimization III
WC45 Supply Chain under Competition
WC46 Environmental Sustainability and Behavior Adoption
WC47 Operations Management III: Topics in OM
WC48 Decision Making by Supply Chain Planners: Empirical Studies and Models
WC49 Portfolio Optimisation: Models and Solution Approaches
WC50 Marketing Strategies and Financial Performance
WC51 Modeling for Innovative Vehicle Technologies
WC52 New Applications in Stochastic Routing
WC53 Maritime Transportation
WC54 Traffic Signal Control and Performance Measurement
WC55 Scheduling in Semiconductor Industry
WC56 Smart Grid Optimization
WC57 Routing for Electric Vehicles
WC58 Business Applications
WC59 Education I: Innovations in Education
WC60 Data Mining for Large Data Analysis
WC61 Data Mining II
WC62 Data Fusion for Manufacturing Systems
WC63 Modeling, Analysis and Prognosis in Service and Manufacturing
WC64 Reliability: Data Mining

WC65 Operations Management in Manufacturing
WC66 Issues in Multi-channel Advertising and Retail
WC67 Decision Models for Adaptive Adversaries
WC68 Operations Decision Support
WC69 Behavioral Operations in Business Management

Wednesday, 3:30pm - 5:00pm

WD01 High-frequency Trading and Market Microstructure
WD02 First Order Method and Tensor Optimization
WD03 Integer Programming Models and Methods for Routing
WD04 Computational Aspects of Mixed-integer Programming
WD05 Large Scale Optimization
WD06 Network Analysis and Resilient Systems
WD07 Applications of Stochastic Programming in Energy and Industry
WD08 Vehicle Routing
WD09 Inventory Management in Retail Operations
WD11 Sports and Entertainment
WD12 Empirical Finance
WD13 Intelligent Agents and Systems
WD14 Manufacturing and Operations Management in Supply Chain
WD15 Service Science Applications in Healthcare Operations
WD16 Incentives in Healthcare
WD17 Scheduling
WD18 Dynamic Programming Methods and Applications
WD19 Stochastic Networks: Approximations and Control
WD20 Pricing and Revenue Management in Transportation and Social Networking
WD21 Health Care VI: Monitoring and Prevention
WD22 Health Care V: Quantitative Approaches in Modeling
WD23 Price and Revenue Optimization for Retail Industry
WD24 Online Pricing and Revenue Management
WD26 Facility Planning II
WD27 Inventory Management: Performance Optimization
WD29 Effective Teams and Organizations
WD30 Integer Programming Applications II
WD31 Financial Econometrics and Statistics
WD32 Networks
WD34 Simulation and Optimization Applications in Manufacturing
WD35 Robust Optimization II
WD36 Health Care X: Performance Enhancing Strategies
WD37 Scheduling Manufacturing Operations
WD38 Supply Chain Management II
WD41 Service Operations Management
WD42 Empirical Service Operations
WD43 Outsourcing
WD44 Supply Chain: Design and Services
WD45 Supply Chain and Game Theory
WD46 Green Supply Chain Management
WD47 Procurement and Purchasing
WD48 Behavioral Operations in Group Settings
WD49 Service Systems: Technology Development and Adoption
WD50 Financial Operations Management under Risk
WD51 Advances in Logistics
WD52 Freight Policy
WD53 Multimodal Transportation Operations
WD55 Strategic Planning and Decision Making
WD56 Integration of Renewable Generation to the Smart Grid and Demand Response
WD57 Facilitating the Participation of Stochastic Energy Resources in Electricity Markets
WD59 Education II: Education Performance
WD60 Data Mining for Healthcare Applications
WD61 Information Systems
WD64 Risk Analysis
WD65 Increasing Productivity in Manufacturing
WD66 Empirical Analysis of Consumer Behavior on Internet Platforms
WD67 Portfolio Decision Analysis
WD68 Product Variety and Assortment Planning in Retail Operations
WD69 Behavioral Studies in Supply Chain Management

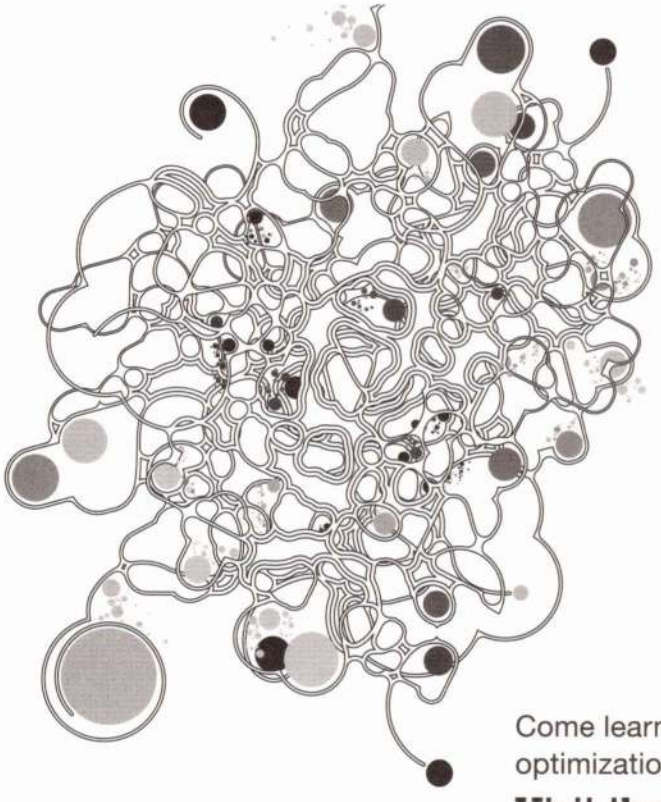
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