

## **Operations Research Center**

The [Operations Research Center](#) (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 61st year of operation in 2013–2014. ORC administers its own graduate programs and a varied research program of methodological and applied projects. It maintains a reading room with a small library as well as state-of-the-art computational workstations and a conference room equipped with distance education equipment.

This report summarizes ORC's AY2014 activities and briefly reviews its educational, research, and outreach programs.

### **Faculty, Students, and Staff**

Professors Dimitris Bertsimas and Patrick Jaillet continue to serve as co-directors of the Operations Research Center.

During AY2014, ORC had 48 affiliated faculty and two staff members, with faculty drawn from the MIT Sloan School of Management and the Departments of Electrical Engineering and Computer Science (EECS), Civil and Environmental Engineering (CEE), Economics, Mathematics, Aeronautics and Astronautics, Mechanical Engineering, Nuclear Science and Engineering, and Urban Studies and Planning.

ORC offers two interdepartmental graduate degree programs, a PhD degree and a master's degree. During the past year, these programs enrolled 73 students: 58 PhD candidates and 15 SM candidates. ORC conferred seven master's degrees and six PhDs. Several other PhD theses were in the final stages of completion in summer 2014.

We had a record year in terms of yield in admissions, receiving 174 applications for the PhD program. We made 21 admission offers, and 18 were accepted. We received 152 applications for the SM program; eight offers were made and seven accepted. ORC's enrollment will be the largest ever in the upcoming academic year, totaling 75 students. Five National Science Foundation (NSF) predoctoral fellows are enrolled at ORC in addition to one US Department of Energy fellow, two National Defense Science and Engineering Graduate fellows, and three Natural Sciences and Engineering Research Council of Canada fellows.

### **Academic Programs**

ORC's academic programs continue to be recognized as among the very best nationally and internationally. Moreover, the programs are repeatedly cited as achieving an excellent balance between application and methodological domains.

### **Research Activities**

Research activities spanned a wide spectrum of methodological topics and applications, ranging from small, unsponsored projects involving one faculty member supervising a student's thesis to larger sponsored programs involving several faculty, staff, and students.

Methodological research includes such topics as linear, nonlinear, and combinatorial optimization; solution methods for integer programming; interior point methods for linear and nonlinear programming; dynamic programming; cluster analysis; parallel and distributed computation and algorithms; network flow algorithms; network design; probabilistic combinatorial optimization; online optimization; deterministic and stochastic facility location; queuing theory, including queuing networks; risk analysis; stochastic processes; classical and Bayesian statistics; game theory; and decision analysis and statistical decision theory.

ORC faculty members contribute to application domains as wide ranging as manufacturing, communications, transportation, public services, logistics, marketing, financial services, health care, and nuclear engineering. Current projects are addressing such topics as air traffic control; epidemiology; cancer treatment; life-cycle modeling of municipal solid waste; safety, risk analysis, and network design in air transportation; telecommunication network design; supply chain management; production scheduling; and transportation logistics, diseases, and disasters.

Several organizations sponsored research projects at ORC during AY2014, including NSF, Draper Laboratory (several projects and Draper fellowships), General Motors, Lincoln Laboratory, ISO New England, the Air Force Office of Scientific Research, the Office of Naval Research, and the Singapore-MIT Alliance for Research and Technology.

### **Outreach and Professional Service**

During AY2014, ORC held multiple faculty meetings to discuss issues of importance to the center. Topics included the possible creation of a new entity at MIT focusing on information and decision systems, statistics, and sociotechnical systems (and the implications of this new entity for ORC) and ORC's strategy regarding the field of analytics.

### **Seminar Series**

The ORC Weekly Seminar Series was privileged to have many distinguished speakers from industry and academia this year. The operations research professionals who made presentations included Yao Zhao (Rutgers Business School), Dan Bienstock (Columbia University), Jim Dai (Georgia Institute of Technology), David S. Johnson (AT&T Labs), Gunnar Carlsson (Ayasdi Inc.), Alex Belloni (Duke University), Sandy Pentland (MIT), David Gamarnik (MIT), Gary King (Harvard University), Gabriel Weintraub (Columbia University), Gad Allon (Northwestern University), Rahul Mazumder (Columbia University), Shane Henderson (Cornell University), Abba Krieger (University of Pennsylvania), Staffan Truvé (Recorded Future), Thomas Rothvoss (University of Washington), George Lan (University of Florida), Jon Kleinberg (Cornell University), Karen Smilowitz (Northwestern University), Ciamac Moallemi (Columbia University), and George Nemhauser (Georgia Tech).

During the January Independent Activities Period (IAP), ORC offered a full-day session titled "Analytics and Big Data" in which several talks focused on the uses of big data in analytics for decision making with applications in finance, retail, medicine, and the use

of social graph data to improve services. Speakers included Bala Chandran (Analytics Operations Engineering), Sepandar Kamvar (MIT), Rama Ramakrishnan (CQuotient), and John Guttag (MIT).

### **Student-Run Programs and Activities**

ORC is very supportive of activities organized by the Institute for Operations Research and the Management Sciences (INFORMS) student chapter. The student chapter held social events that fostered a feeling of camaraderie among students and helped improve life at the center. Often these INFORMS events are used as opportunities to meet students from other MIT programs. ORC is proud of the friendly and inclusive environment we foster for our students. Student activities and events this year included:

- A Valentine's Day cupcake event held jointly with students from the Laboratory for Information and Decision Systems.
- The Taste of Greece Luncheon, a social event with a sampling of traditional Greek foods. ORC embraces its cultural diversity and encourages its students to share their culture with the rest of the community.
- The Rooftop Garden Luncheon, at which students enjoyed lunch together outside at the Cambridge Center Roof Garden.
- An end-of-year BBQ organized with students from the Engineering Systems Division. Food was shared along with games and activities.
- Social Fridays, gatherings encouraging all ORC students to get together on Friday afternoons.

ORC is also proud of the work done by our student REFS (Resources for Easing Friction and Stress) volunteers. This program is run by students who complete training in conflict resolution and are familiar with other resources offered at MIT. They make themselves available as moderators for conflicts and as confidants for students who may be experiencing difficulties. We feel this is an invaluable resource to our students. The student volunteers also organize events centered on reducing stress and tension, including social events designed to increase awareness of the REFS program and allow discussion of student issues and concerns.

### **Future Plans**

The ORC program is stable and does not face any unusual challenges. The two newly introduced PhD tracks in operations management and networked systems have been successful thus far, and we have plans for an additional track in analytics in the coming year. ORC will continue to work in collaboration with the newly formed Accenture and MIT Alliance in Business Analytics. We also plan to explore possible further synergies and collaborations with other units within MIT. In addition, we will continue work toward the establishment of the proposed enhanced and larger SM program in decision analytics. We are working on a potential major redesign of our center's physical space as well. This redesign will be essential as plans for the larger SM program move forward. ORC intends to play a larger role in decision analytics and statistics within the Institute.

## Diversity

ORC has always attempted to provide an environment that is responsive to the varied professional and personal needs of MIT's operations research community and that builds diversity. Of the center's two staff members (a support staff person and an academic program administrator), one is a woman. Twelve of our current graduate students are women. Over the past several years, we have made efforts to attract qualified women and underrepresented minorities to our graduate programs by targeting information to math departments in liberal arts colleges and by sending information to historically black colleges.

## Professional Activities

### Faculty

Daron Acemoglu was elected to the National Academy of Sciences (NAS). Members are elected to NAS in recognition of their distinguished and continuing achievements in original research. Membership is a widely accepted mark of excellence in science and is considered one of the highest honors that a scientist can receive.

Itai Ashlagi and Peng Shi won the 2013 INFORMS Public Sector OR Section Best Paper Competition. This competition is intended to encourage journal-quality research in all of the disciplines and application areas represented within the Public Sector OR Section.

Itai Ashlagi, David Gamarnik, and Ross Anderson are finalists for the 2014 INFORMS Franz Edelman Prize. The Edelman Prize recognizes contributions in operations research and analytics.

Cynthia Barnhart was named MIT's new chancellor.

Dimitris Bertsimas, Allison O'Hair, Steve Relyea, and John Silberholz received the 2013 INFORMS William Pierskalla Best Paper Award in the health care category for "An Analytics Approach to Designing Clinical Trials for Cancer." The Pierskalla Award recognizes research excellence in the field of health care management science.

Dimitris Bertsimas also was awarded the 2013 INFORMS Philip McCord Morse lectureship, which honors individuals who have made outstanding contributions to the operations research profession.

Dimitris Bertsimas, Amedeo Odoni, and Guglielmo Lulli (from the University of Milan in Italy) received the 2013 INFORMS Best Paper Award in the transportation science and logistics (TSL) category for "An Integer Optimization Approach to Large-Scale Air Traffic Flow Management." This annual award recognizes outstanding papers in the TSL field.

Erik Brynjolfsson and Duncan Simester received the first annual Management Science Best Paper Award in Information Systems from the INFORMS Information Systems Society. This award recognizes the best contribution to the theory and practice of information systems among papers published in *Management Science* in the previous

three years. Their winning article, “Goodbye Pareto Principle, Hello Long Tail: The Effect of Search Costs on the Concentration of Product Sales,” was co-authored with Jeffrey Hu.

Patrick Jaillet was inducted as an INFORMS fellow for “opening the field of a priori optimization for stochastic programming and for being regarded as the world leader in the field of probabilistic and online optimization.” INFORMS fellows have demonstrated exceptional accomplishments and made significant contributions to the advancement of operations research and the management sciences.

Richard Larson and Anna Teytelman were selected as the recipients of the 2013 International Society for Pharmacoeconomics and Outcomes Research (ISPOR) Value in Health Paper of the Year Award for “Modeling the Effects of H1N1 Influenza Vaccine Distribution in the United States.” This award was established in 2011 to promote quality research, originality, and utility in articles published in *Value in Health*.

Retsef Levi, along with Yale Herer and Assaf Avrahami, won the 2013 INFORMS Daniel H. Wagner Prize for Excellence in Operations Research Practice for “Matching Supply and Demand via Delayed 2-Phase Distribution at Yedioth Group—Models, Algorithms and IT.” The Daniel H. Wagner Prize emphasizes analysis quality and coherence in operations research practice.

John Little was the International Federation of Operational Research Societies (IFORS) plenary speaker at the Euro-INFORMS 2013 conference in Rome.

Andrew Lo was inducted into the 233rd class of members of the American Academy of Arts and Sciences. The academy’s membership encompasses over 4,600 fellows and 600 foreign honorary members and reflects the full range of disciplines and professions. Among the academy’s fellows are more than 250 Nobel laureates and 60 Pulitzer Prize winners. Lo also received the 2014 Samuel M. Seegal Prize from the Sloan School of Management in recognition of his efforts to inspire students in pursuing and achieving excellence.

Eytan Modiano, his student Krishna Jagannathan, and their co-authors received the IEEE WiOpt 2013 Best Paper Award for “Scheduling Strategies to Mitigate the Impact of Bursty Traffic in Wireless Networks.”

Carolina Osorio received an NSF CAREER Award for her project “Simulation-Based Optimization Techniques for Urban Transportation Problems.” CAREER Awards are NSF’s most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of the mission of their organizations. Osorio also won the CEE Maseeh Excellence in Teaching Award, which recognizes the department’s most outstanding faculty instructor in the past academic year.

Pablo Parrilo received the 2013 Farkas Prize from the INFORMS Optimization Society. The Farkas Prize, established in 2006, is awarded annually to a midcareer researcher for outstanding contributions to the field of optimization.

Georgia Perakis received the 2014 Jamieson Prize for Excellence in Teaching Award, the most prestigious teaching prize offered by the Sloan School of Management. The award was established in 2006 and is presented each year to two MIT Sloan faculty members, as well as two EECS faculty members, for their contributions to educational excellence at MIT.

Cynthia Rudin was the winner of the INFORMS Innovative Applications in Analytics Award for her paper “Machine Learning for Power Grid Reliability: Predicting Manhole Events in New York City.” This award recognizes creative and unique applications of analytical techniques in new areas.

Devavrat Shah and Jinwoo Shin received the 2013 Best Publication Award from the INFORMS Applied Probability Society for “Randomized Scheduling Algorithm for Queueing Networks.” The award recognizes outstanding contributions to the field of applied probability.

David Simchi-Levi was inducted as a distinguished Manufacturing and Service Operations Management Society (MSOM) fellow in August 2013. MSOM fellowships recognize outstanding research and scholarship in operations management.

John Tsitsiklis and Kuang Xu received the Best Paper Award at the 2013 Association for Computing Machinery (ACM) SIGMETRICS conference for “Queueing System Topologies with Limited Flexibility,” and Xu received the Kenneth C. Sevick Outstanding Student Paper Award for the same paper. This is the first time that both awards were given to the same paper at SIGMETRICS since its inception in 1973.

Juan Pablo Vielma won second place in the INFORMS Junior Faculty Interest Group paper competition. Also, he received an NSF CAREER Award for his project “Advanced Mixed Integer Programming Formulations.”

Karen Zheng was named runner up for the INFORMS Behavioral Operations Management Section Best Working Paper Award. Her paper, coauthored with Ozalp Ozer and Yufei Ren, was titled “Trust, Trustworthiness, and Information Sharing in Supply Chains Bridging China and the U.S.”

### **Students**

Vishal Gupta and Nathan Kallus were finalists in the 2013 INFORMS George Nicholson Student Paper Competition, held each year to honor outstanding papers in the field of operations research and the management sciences written by students.

Kris Johnson won the Graduate Student Award for Excellence in Engineering Systems Teaching for her work as a teaching assistant in ESD.267 Supply Chain Planning and ESD.268 Manufacturing Systems and Supply Chain Design.

Benjamin Letham, along with Cynthia Rudin, Tyler H. McCormick, and David Madigan, won the 2013 INFORMS Data Mining Best Student Paper Award for “An Interpretable Stroke Prediction Model Using Rules and Bayesian Analysis.”

Maokai Lin and Hai Wang (along with their collaborator Jiangang Jin of Shanghai Jiao Tong University in China) received first prize in the INFORMS Railway Applications Section Problem Solving Competition. Setareh Borjian was awarded the second-place prize in the competition.

Miles Lubin won the 2013 COIN-OR INFORMS Cup along with Cosmin Petra and Mihai Anitescu of Argonne National Laboratory and Julian Hall of the University of Edinburgh for their work on parallelizing the simplex algorithm for structured linear programs on COIN-OR open-source software.

Peng Shi won the 2013 INFORMS Doing Good with Good OR Student Paper Competition for “Guiding School Choice Reform through Novel Applications of Operations Research.” This student competition is held each year to honor outstanding projects in the field of operations research and the management sciences.

Zhe Zhu was awarded an honorable mention in the 2013 INFORMS Financial Services Section Best Student Paper competition.

### **Alumni**

Jason Acimovic was the winner of the 2013 Council of Supply Chain Management Professionals Doctoral Dissertation Award, which recognizes doctoral students who demonstrate significant originality and technical competence in any supply chain function. He also won the 2013 INFORMS George B. Dantzig Dissertation Award, given for the best dissertation in any area of operations research and the management sciences.

Dan Iancu and Nikolaos Trikakis won the INFORMS Junior Faculty Interest Group paper competition.

Garrett van Ryzin won second place in the INFORMS Case and Teaching Materials Competition.

**Dimitris Bertsimas**

**Co-director**

**Boeing Professor of Operations Research**

**Patrick Jaillet**

**Co-director**

**Dugald C. Jackson Professor of Electrical Engineering and Computer Science**