

## Operations Research Center

The [Operations Research Center](#) (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 63rd year of operation in 2015–2016. 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 servers.

This report summarizes ORC's AY2016 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 AY2016, ORC had 51 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, 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 80 students: 72 PhD candidates and 8 SM candidates. ORC conferred five master's degrees and nine PhDs. Several other PhD theses were in the final stages of completion in summer 2016.

We had an outstanding year in terms of yield in admissions, receiving 258 applications for the doctoral program. We made 20 admission offers, and 16 were accepted. In addition, we received 79 applications for the SM program; nine offers were made, and five were accepted. Two National Science Foundation (NSF) predoctoral fellows are enrolled at ORC.

We continue to place our students exceptionally well in both academic and industrial jobs. For example, this year graduates accepted positions as assistant professors at Georgia Tech, the University of Southern California, and the University of California, Los Angeles.

### 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, nuclear engineering, and personalized medicine. 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 AY2016, including NSF, Draper Laboratory (Draper fellowships), the Food and Drug Administration, General Motors, Accenture, Lincoln Laboratory, the Air Force Office of Scientific Research, the Office of Naval Research, Sapient, Mitsubishi, and the Singapore-MIT Alliance for Research and Technology.

## Outreach and Professional Service

During AY2016, ORC held multiple faculty meetings to discuss issues of importance to the center. Topics included ORC's planned update of its website, how to improve the center's overall web presence, and the new master of business analytics program. Also, a tour of the center's newly renovated space was held.

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 Ozlem Ergun (Northeastern University), Yinyu Ye (Stanford), Martin Copenhaver (ORC), Robert Phillips (Columbia), Tamara Broderick (MIT), Chris Tang (University of California, Los Angeles), Huseyin Topaloglu (Cornell), Jan Vondrak (IBM), Michel Gendreau (Ecole Polytechnique de Montreal), David Simchi-Levi (MIT), Rene Caldentey (New York University); Daniel Kuhn (École Polytechnique), Peter Frazier (Cornell), Dimitris Bertsimas (MIT), Aaron Sidford (Microsoft Research), Ali Aouad (ORC), Stefanie Jegelka (MIT), Sebastian Pokutta (Georgia Tech), Sharad Goel (Stanford), Pascal Van Hentenryck (University of Michigan), Nicoleta Serban (Georgia Tech), and Dick den Hertog (Tilburg University).

During the January Independent Activities Period, ORC offered a full-day session titled “Analytics in Operations Research” in which several talks explored the role and impact of analytics in improving decision making. Speakers included John Silberholz (MIT), Dean Eckles (MIT), Jae-wook Ahn (IBM), and Jon Petersen (Uber).

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

ORC is very supportive of activities organized by the INFORMS (Institute for Operations Research and the Management Sciences) 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 very proud of the friendly and inclusive environment we foster for our students. Student activities and events this year included:

- INFORMS Ice Cream Social: a stress relief opportunity for students taking the qualifying exam
- INFORMS “Back to School” lunch: an event allowing guests to reconnect with continuing students and meet new students at ORC
- ORC reunion at the annual INFORMS conference: an informal “reunion” event that allowed current students to touch base with ORC alums
- Course selection party: a social event held by INFORMS officers and Resources for Easing Friction and Stress (REFS) allowing students to talk with each other about what courses to take
- Chinese New Year celebration: a social event at which ORC students celebrated the Chinese New Year
- 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 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 organized 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 has been expanding. The center has increased its total number of students, and the new master of business analytics program will begin in the fall 2016 term. It is our hope that interactions and collaborations between these new students and current ORC students will be beneficial to all. MBAn students will also be working closely with companies as part of their program, which should result in improved visibility for ORC and may encourage research collaborations.

We have moved into our renovated space, which has a much more open floor plan with shared areas to facilitate collaboration between students. We also plan to encourage our

student INFORMS chapter and REFS students to continue planning social events and opportunities for students to help each other in their pursuits.

ORC intends to play a larger role in analytics and statistics within the Institute. We hope to be an academic leader in this growing field moving forward.

## 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 administrator), one is a woman. Fourteen 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

Arnold Barnett was awarded the Sloan School's Jamieson Prize for Excellence in Teaching, the school's most prestigious teaching prize. The Jamieson Prize was established in 2006 and is awarded each year to two MIT Sloan faculty members and two EECS faculty members for their contributions to educational excellence at MIT.

Cynthia Barnhart was awarded a doctor of science honoris causa degree from the University of Toronto for her leading contributions to the field of operations research and her outstanding service to her students and the academic community.

Dimitris Bertsimas won the 2016 Harold Larnder Prize. The prize is awarded annually to an individual who has achieved international distinction in operational research. The prize winner delivers the Harold Larnder Memorial Lecture, on a topic of general interest to operational researchers, at the national conference of the Canadian Operational Research Society.

Erik Brynjolfsson and Andy McAfee won the 2015 German Business Book Award for *The Second Machine Age*. The book established the standard reference for a new industrial world in which machines talk to machines, robots pass objects using sensor skin on their gripper arm, and systems learn by themselves.

Vivek Farias won the INFORMS Revenue Management and Pricing Section Prize, which recognizes the "best contribution to the science of pricing and revenue management published in English." Vivek was honored for his paper "A Nonparametric Approach to Modeling Choice with Limited Data" (coauthored with Srikanth Jagabathula of the New York University Stern School of Business and Devavrat Shah of EECS). The award was presented at the 2015 INFORMS annual meeting in Philadelphia.

Vivek Farias and Devavrat Shah received the 2016 Best OM Paper in Management Science Award from the INFORMS Manufacturing and Service Operations Management Society. Their winning paper (coauthored with Srikanth Jagabathula of New York University) was titled “A Nonparametric Approach to Modeling Choice with Limited Data.”

Richard Larson and his student Yi Xue won the Lawrence M. Klein Fund Best Paper of the Year Award for “STEM Crisis or STEM Surplus? Yes and Yes,” published in *Monthly Labor Review*. The purpose of the award is to encourage articles that exhibit originality of ideas, adhere to principles of scientific inquiry, and are well written.

Andrew Lo received the Investment Management Consultants Association’s Richard J. Davis Ethics, Legal, Regulatory Insight Award for his paper “The Gordon Gekko Effect: The Role of Culture in the Financial Industry.” The award honors articles that have made a significant contribution to advancing the understanding and knowledge of investment consulting and/or private wealth management.

Amedeo Odoni supervised the PhD thesis of Alexandre Jacquillat (Engineering Systems Division), which won the INFORMS 2015 George B. Dantzig Dissertation Award. The thesis was titled “An Alternative Approach to Capacity Allocation at Congested Airports.”

Carolina Osorio was invited to be a speaker at the upcoming National Academy of Engineering EU-US Frontiers of Engineering symposium. Her talk will focus on future urban mobility.

Cynthia Rudin advises student Tong Wang, who won second place in the 2015 INFORMS Doing Good with Good OR Student Paper Competition for “Finding Patterns with a Rotten Core: Data Mining for Crime Series Detection.” Cynthia and Tong worked on the paper together.

John Tsitsiklis won the 2016 Association for Computing Machinery SIGMETRICS Achievement Award in recognition of his fundamental contributions to decentralized control and consensus, approximate dynamic programming, and statistical learning.

Juan Pablo Vielma won first place in the INFORMS 2015 JFIG (Junior Faculty Interest Group) Paper Competition. His winning paper, which he recently submitted for possible publication in *Mathematics of Operations Research*, was titled “Embedding Formulations and Complexity for Unions of Polyhedra.” Juan Pablo also won the 2015 Best Publication Award in Natural Resources from the INFORMS Section on Energy, Natural Resources, and the Environment for “Imposing Connectivity Constraints in Forest Planning Models.” This paper, coauthored with Rodolfo Carvajal (Georgia Tech), Miguel Constantino (Universidade de Lisboa, Portugal), Marcos Goycoolea (Universidad Adolfo Ibáñez, Chile), and Andres Weintraub (Universidad de Chile), was published in *Operations Research*.

Karen Zheng won second prize in the INFORMS Behavioral Operations Management Section Best Working Paper Competition. Karen was honored for her working paper “Transparency and Indirect Reciprocity in Social Responsibility: An Incentivized Experiment,” coauthored with Tim Kraft (of the University of Virginia’s Darden School of Business) and her PhD student Leon Valdes (of MIT Sloan).

### Students

Wang-Chi Cheung was a finalist in the 2015 George Nicholson Student Paper Competition for his paper “Sampling-Based Approximation Schemes for Capacitated Stochastic Inventory Control Models.”

Maxime Cohen and Charles Thraves won the Production and Operations Management Society College of Supply Chain Management 2015 Best Student Paper Competition for “Competition and Externalities in Green Technology Adoption.”

Tamar Cohen won the Rothblum Prize from ORSIS (Operations Research Society of Israel) for her master’s thesis, “The Periodic Joint Replenishment Problem Is Strongly NP-Hard.” The award acknowledges excellence in operations research.

Iain Dunning, Joey Huchette, and Miles Lubin won the 2015 COIN-OR Cup competition for their work on JuMP, an open-source optimization modeling language.

Paul Grigas won the 2015 INFORMS Optimization Society Student Paper Prize for “A New Perspective on Boosting in Linear Regression via Subgradient Optimization and Relatives,” coauthored with Rob Freund and Rahul Mazumder.

Jerry Kung received the 2015–2016 Sloan Outstanding Teaching Assistant Award for his work in 15.060 Data, Models, and Decisions.

Jerry Kung and Chiwei Yan won first place in the 2015 AGIFORS Anna Valicek Award Paper Competition for “Robust Aircraft Routing.” The Anna Valicek prize recognizes original and innovative applications of operations research to airline and/or airline-related business problems.

Chiwei Yan won the 2015 INFORMS Aviation Application Section Best Presentation Award.

### Alumni

Charu Aggarwal received the IEEE (Institute of Electrical and Electronics Engineers) ICDM (International Conference on Data Mining) Research Contributions Award. This award, the highest recognition for research achievements in the field of data mining, is presented annually to individuals or groups making influential contributions to the field.

Margaret L. Brandeau received the 2015 Philip McCord Morse Lectureship Award. This award is presented in honor of Morse, who made pioneering contributions to operations research and the management sciences.

Pitu Mirchandani was named an INFORMS Fellow for his fundamental research contributions to dynamic and stochastic networks, location models, adaptive control of transportation systems, and traffic modeling and analysis.

**Dimitris Bertsimas**

**Co-Director**

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**Patrick Jaillet**

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