Operations Research Center

The Operations Research Center (ORC), established in 1953 as a first-of-a-kind interdepartmental graduate degree program, completed its 65th year of operation in academic year 2018. The ORC administers its own graduate program and a varied research program of methodological and applied projects. This report summarizes AY2018 activities and briefly reviews the center's educational, research, and outreach programs.

Faculty, Students, Staff

Professor Dimitris Bertsimas and Professor Patrick Jaillet continue to serve as co-directors of ORC.

During AY2018, ORC had 56 affiliated faculty and two staff members. Faculty members were drawn from the MIT Sloan School of Management and the Departments of Electrical Engineering and Computer Science, Civil and Environmental Engineering, Economics, Mathematics, Computer Science, Aeronautics and Astronautics, Mechanical Engineering, Nuclear Science and Engineering, and Urban Studies and Planning.

ORC offers two interdepartmental graduate degree programs, a doctoral program and a master's degree program. During the past year, these programs enrolled 85 students—75 PhD candidates and 10 SM candidates. ORC conferred five SMs and 15PhDs. Several other PhD theses were in the final stages of completion in summer 2018.

The center had an outstanding year in terms of yield in admissions. There were 232 applications for the doctoral program; 24 applicants were offered admission and 15 of them accepted. There were 157 applicants for the SM program; the center made nine offers of admission, seven of which were accepted.

ORC continues to place its students exceptionally well in both academic and industrial jobs. This year, graduates were placed as assistant professors at Carnegie Mellon University, the London Business School, Rice University, and Brigham Young University.

Academic Programs

ORC's academic programs continue to be ranked 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.

There has been increasing emphasis on the interface between machine learning and optimization, data-driven optimization, and algorithms for convex, discrete, stochastic, and robust optimization on the methodological side. On the application

side, the emphasis has been on the interface between personalized medicine, operations management, and pricing. More, ORC faculty members continue to contribute to application domains as wide-ranging as manufacturing, communications, transportation, public services, logistics, marketing, financial services, and health care.

Several organizations sponsored research projects at ORC during AY2018, including the National Science Foundation, Draper Laboratory (Draper fellowships), the US Food and Drug Administration, General Motors Company, Lincoln Laboratory, the Office of Naval Research, Sapient Corporation, Mitsubishi Group, Anheuser-Bush InBev, CIBC, the Swiss Reinsurance Company Ltd., ISN Software Corporation, Beth Israel Deaconess Medical Center, Hartford Hospital, Quest Diagnostics Inc., and the Singapore-MIT Alliance Program.

Outreach and Professional Service

During the AY2018, ORC held multiple faculty meetings to discuss important issues pertaining to the center. Topics included:

- The visibility of the ORC
- Updates on the master of business analytics program
- A proposed dual-degree PhD in statistics and operations research
- A proposed ORC 65th anniversary event
- Updates on the ORC's admissions

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 Wilfred Amaldoss (Duke University); Andrew Li (MIT); Madeleine Udell (Cornell University); Sam Pimentel (University of California); Sheldon Jacobson (University of Illinois); Mohit Tawarmalani (Purdue University); Nicolas Stier (Facebook); David Sontag (MIT); Jónas Jónasson (MIT); Mor Armony (New York University); Bill Lovejoy (University of Michigan); Alper Atamtürk (Microsoft Research); Russell Barton (Pennsylvania State University); Omar Besbes (Columbia University); Damek Davis (Cornell University); and R. Srikant (University of Illinois).

The ORC also offered, during January Independent Activities Period, a full-day session, "Operations Research for Social Good." Several of the talks given that day focused on the speakers' work, research, and careers and discussed the future of operations research. The speakers included Michael Johnson (University of Massachusetts, Boston); Arthur Delarue and Sebastien Martin (MIT); Andrew Therriault (chief data officer, City of Boston); Hamsa Bastani (IBM Research); and Marta C. Gonzalez (University of California, Berkeley).

Student-Run Programs and Activities

The ORC is very supportive of activities organized by the student chapter of the Institute for Operations Research and the Management Sciences (INFORMS). The student chapter held

social events that fostered a feeling of camaraderie among students and helped to improve life at the center. Often these INFORMS events serve as opportunities to meet students from other MIT programs. The ORC is proud of the friendly and inclusive environment the center fosters for its students. Student activities and events this year included:

- A beginning of the semester lunch, a coffee and bagel event, Social Fridays, and coffee and snack break events throughout the year
- Celebrations for Lunar New Year, π-Day, and Cinco de Mayo
- A student-run staff appreciation event
- ORC Olympics, in which students competed in a variety events over the summer

ORC is also very proud of the work done by its student Resources for Easing Friction and Stress (REFS) volunteers. This program is run by student volunteers who complete training in conflict resolution and are familiar with resources offered at MIT. They make themselves available as moderators for conflicts and as confidants for students who may be experiencing difficulties. They have also begun meeting with each new student just to check in and make sure every ORC student knows the REFS are there to help with any pressure or issues they may be having. Additionally, the REFS have organized small lunches where ORC students can meet with ORC faculty members and have organized events centered on reducing stress and tension. These include social events to increase awareness of the REFS program and to discuss student issues and concerns. The center's staff members find that the REFS are an invaluable resource for ORC students.

Fellowships

ORC has received fellowship support from the MIT Sloan School of Management for doctoral students. In addition, the center received an endowed fellowship (the Henry Gabbay Fellowship) from an ORC alumnus to partially support an ORC doctoral student.

Future Plans

The ORC program has been expanding. ORC has increased its total number of enrolled students and the new master's of business analytics (MBAn) program had its second class of 30 students, who were provided shared desk space at ORC. It is hoped that the interaction and collaboration between these new students and the current ORC students will be beneficial to all. These MBAn students work closely with companies as part of the program, which should encourage research collaboration and result in improved visibility for ORC. Almost all the capstone research for MBAn students is supervised by ORC faculty members.

The center plans to encourage the student INFORMS chapter and the REFS students to continue planning social events and opportunities for students to help each other in their pursuits. ORC also intends to play a larger role in analytics and statistics within the Institute. In this context, the ORC is offering subjects 15.071 The Analytics Edge and 15.095 Machine Learning Under a Modern Optimization Lens.

Diversity

The ORC has long attempted to provide an environment that responds to the varied professional and personal needs of the operations research community at MIT and that builds diversity. During AY2018, the staff of ORC comprised one support staff member and one academic administrator. One of these two staff members is a woman. As for the student population, 26 of ORC's graduate students were women. In past years, the ORC has made efforts to attract qualified women and members of underrepresented minority groups to the center's graduate programs by targeting information to mathematics departments in liberal arts colleges and by sending information to historically black colleges and universities.

Professional Activities

Faculty

Sinan Aral received the 2017 Herbert Simon Award of Rajk László College in Budapest, Hungary. He was also named a 2018 MSI Scholar by the Marketing Science Institute (MSI).

Colin Fogarty was awarded the Thomas R. Ten Have Award by the organizing committee of the 2017 Atlantic Causal Inference Conference, based upon work in the manuscripts "On Mitigating the Analytical Limitations of Finely Stratified Experiments" and "Regression Assisted Inference for the Average Treatment Effect in Paired Experiments."

Dimitris Bertsimas's teaching was honored by being selected for Class Central's Top 50 MOOCS of All Time (2017 edition) list, based on thousands of reviews by Class Central users for the subject 15.071x The Analytics Edge, delivered via edX.

Steve Graves and Jason Acimovic won the 2017 Manufacturing and Service Operations Management Best Paper Award for the 2015 paper "Making Better Fulfillment Decisions on the Fly in an Online Retail Environment."

Steve Graves has been elected a member of the National Academy of Engineering.

Patrick Jaillet and John Tsitsiklis's massive open online course, 6.041x Introduction to Probability—The Science of Uncertainty, was highlighted by Class Central as the highest-rated class in statistics and probability.

Stefanie Jegelka received a Young Faculty Award from the Defense Advanced Research Projects Agency.

Jónas Jónasson received the Grand Challenges Explorations Grant in Innovations for Integrated Diagnostics Systems from the Bill and Melinda Gates Foundation.

Dick Larson received the first-ever Daniel Berg Lifetime Achievement Medal from the International Academy of Information Technology and Quantitative Management. The medal is presented to an individual who has made significant contributions to technology innovation, service systems, and strategic decision making over his or her lifetime.

Andrew W. Lo won the 2017 Harry M. Markowitz Award for the paper, "Moore's Law Vs. Murphy's Law in the Financial System: Who's Winning?" The award honors the legacy of Harry M. Markowitz and supports future research and innovation in practical asset management. He also won the 2018 Professional and Scholarly Excellence (PROSE) Award for Excellence in Social Sciences for his book *Adaptive Markets: Financial Evolution at the Speed of Thought*. The PROSE annual awards recognize "the very best in professional and scholarly publishing by bringing attention to distinguished books, journals, and electronic content in 58 categories."

Andrew Lo was named Risk Manager of the Year for 2017 by the Global Association of Risk Professionals. He also received the Managed Futures Pinnacle Achievement Award presented by CME Group and BarclayHedge. The award honors the top managers in the industry today.

Rahul Mazumder received the 2018 Young Investigator Program Award from the Office of Naval Research.

Eytan Modiano received the 2018 MIT Committed to Caring Award.

Eytan Modiano, Igor Kadota, and Abhishek Sinha received a 2018 Best Paper Award at the IEEE International Conference on Computer Communications for the paper, "Optimizing Age of Information in Wireless Networks with Throughput Constraints."

Amedeo Odoni received the Robert Horonjeff Award for 2018 from the American Society of Civil Engineers. He was named honorary dean of the School of Civil Aviation of Nanjing University of Aeronautics and Astronautics. He also won the 2017 Best Paper Award from the INFORMS Transportation Science and Logistics Section. The paper was co-authored with former doctoral student Alexandre Jacquillat.

Pablo A. Parrilo was elected a fellow of the Society for Industrial and Applied Mathematics.

Georgia Perakis and Max Biggs were finalists for the 2017 INFORMS Best Paper of the Service Science Section Cluster Award for their paper, "A Ranking Algorithm for Shipping in the Spot Market."

David Simchi-Levi, Nikos Trichakis, and Peter Yun Zhang received second place in the Best Paper Award, Humanitarian Operations and Crisis Management competition, at the Production and Operations Management Society (POMS) 29th annual conference for their paper, "Designing Response Supply Chain Against Bioattacks."

John N. Tsitsiklis won the 2017 INFORMS Saul Gass Expository Writing Award and the 2018 IEEE Control Systems Award. He also won the 2017 National Hellenic Operational Research Society Award. The Athens University of Economics and Business awarded him an honorary doctorate.

Juan Pablo Vielma won the INFORMS Computing Society Prize for the best English-language paper or group of related papers dealing with the operations research/

computer science interface. He also received the Presidential Early Career Award for Scientists and Engineers.

Students

Muhammad Amjad and Devavrat Shah, along with co-authors Anish Agarwal and Dennis Shen, received the best poster award at the Neural Information Processing Systems Time Series Workshop 2017 for their work titled "Time Series Forecasting = Matrix Estimation."

Muhammad Amjad and Devavrat Shah, along with co-author Dennis Shen, received second place at the INFORMS 2017 Poster Presentation Award for the work titled Robust Synthetic Control.

Lennart Baardman, Igor Levin, Georgia Perakis, and Divya Singhvi received first place at the Applied Research Challenge competition for the paper "Leveraging Comparables for New Product Sales Forecasting."

Lennart Baardman and Divya Singhvi received the Best Student Paper Award at the POMS conference for the paper "Leveraging Comparables for New Product Sales Forecasting."

Lennart Baardman received the 2018 MIT Sloan Outstanding Teaching Assistant Award as a teaching assistant for the Open Courseware subject 15.060 Data, Models, and Decisions.

Andrew Li was awarded first place in the 2017 George Nicholson Student Paper Competition for the paper, "Learning Preferences with Side-information."

Julia Romanski received a 2018 Microsoft Research PhD fellowship.

Bradley Sturt was awarded second place in the 2017 George Nicholson Student Paper Competition for the paper, "Computation of the Bootstrap: Complexity, Exact Algorithms and Deterministic Approximations."

Will Ma was a finalist in the 2017 George Nicholson Student Paper Competition for the paper, "Online Resource Allocation under Arbitrary Arrivals: Optimal Algorithms and Tight Competitive Ratios." He received honorable mention in the 2017 INFORMS Optimization Society Student Paper Competition for the paper, "Improvements and Generalizations of Stochastic Knapsack and Markovian Multi-armed Bandit Approximation Algorithms." Will Ma also won the Best Paper Award of the Columbia Business School's Chinese Scholars Association for Management Science and Engineering for the paper, "Dynamic Recommendation at Checkout under Inventory Constraint."

Anna Papush, Pavithra Harsha, and Georgia Perakis received the 2017 INFORMS Best Paper of the Service Science Section Cluster Award for the paper, "A Data-Driven Approach to Personalized Bundle Pricing and Recommendation."

Sharon Xu received first place in the Pecan Street Student Research Competition 2018.

Alumni

Pavithra Harsha and Joline Uichanco, along with Markus Ettl and Shivaram Subramanian, won the 2017 INFORMS Revenue Management and Pricing Practice Award for "Omni-channel Markdown Optimization."

Jerry Kung and Chiwei Yan won the 2017 INFORMS Transportation Science and Logistics Section Outstanding Paper in Air Transportation Award for the paper "Robust Aircraft Routing."

Rong Yuan received honorable mention in the 2017 George B. Dantzig Dissertation Award competition.

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