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Message from the Department Head

I cannot imagine a better time to be Head of the ISyE Department. We have had six years of sustained growth since becoming a department in 2012 — and plans are underway for further expansion. Our undergraduate program is thriving with an incoming class of over 90 students. We have also just graduated our largest ever class. Our students are in high demand, employed by leading companies in manufacturing, logistics, consulting, banking, retail, and healthcare, among many others, with starting salaries that are among the highest in the college. Our students are among the most diverse in the college and I am particularly proud that nearly 50% of incoming ISyE undergraduate students are women.

Our graduate program is also thriving. We continue to attract high caliber students from the very best schools in the US and abroad. We have just graduated our largest batch of doctoral students, with several of our graduates securing academic jobs in top engineering and business schools.

This year also marks the launch of our new MS in Analytics, a highly interdisciplinary program that blends operations research, computer science, and statistics to support data-driven decision making in a wide range of applications. The program, which can be completed in three semesters, emphasizes project-based learning and a deep engagement with industry, including an industry-sponsored capstone project.

With growth in our undergraduate and graduate programs, our faculty has also grown — nearly tripling in size since 2012. This fall, we welcomed Jean-Philippe Richard, a leading scholar in the field of optimization, as a new faculty member. Our faculty are working on cutting edge problems, and their work is being published in top journals. In particular, our faculty are among the most well-published research groups in the world in the INFORMS flagship journals OR, MS, and MSOM.

True to our name, we are deeply engaged with industry. Our senior design projects are now 100 percent sponsored and funded by industry! Our faculty have been leading a unique program funded by the National Science Foundation that brings together academics and industry to work collaboratively on challenging problems in analytics. We are about to embark on a unique collaboration with the Mayo Clinic to tackle challenging problems in healthcare.

As you can see, a lot is happening in ISyE. We have momentum and we have tremendous energy. We have big ambitions as we set our sights on not just being a great department but one of the very best!

We owe a big debt of gratitude to my predecessor, Shuzhong Zhang, who successfully led the department since it began in 2012. We are also grateful to our directors of undergraduate and graduate studies, Lisa Miller and Bill Cooper. Much of what we have accomplished is because of their efforts.

Please dig into this newsletter to learn more about ISyE. Hopefully, you will find something interesting, exciting, perhaps even inspiring. This magazine is just the first example of our commitment to better share ISyE news and updates.

I will end with a request: please get in touch. Are you inspired by something you read here? Do you have an idea for a project? Would you like to support student scholarships or faculty research? Please send me an email or give me a call. ISyE is growing, and we want you to be a part of the story.

"We have big ambitions as we set our sights on not just being a great department but one of the very best."
FACULTY

**Saif Benjaafar**  
Distinguished McKnight University Professor  
PhD Purdue 1992  
Operations management, supply chains, service systems, sharing economy, sustainability

**William Cooper**  
Professor  
PhD Georgia Tech 1999  
Stochastic modeling, pricing, revenue management, applied probability

**Sherwin Doroudi**  
Assistant Professor  
PhD Carnegie Mellon 2016  
Stochastic modeling, queuing systems, computer security

**Darin England**  
Teaching Assistant Professor  
PhD Minnesota 2006  
Optimization, simulation, machine learning

**Qie He**  
Assistant Professor  
PhD Georgia Tech 2013  
Optimization, computation, transportation, healthcare
Guangwen Kong  
Assistant Professor  
PhD USC 2013  
Operations management, supply chains, sharing economy, contract design

Kevin Leder  
Associate Professor  
PhD Brown 2008  
Stochastic modeling, cancer evolution, probability theory

Ankur Mani  
Assistant Professor  
PhD MIT 2014  
Peer and network interactions, pricing, matching and mechanism design

Lisa Miller  
Teaching Professor  
PhD Georgia Tech 2002  
Optimization, operations research, analytics

Dan Mitchell  
Assistant Professor  
PhD UT Austin 2014  
Financial engineering, stochastic control, option pricing

Diana Negoescu  
Assistant Professor  
PhD Stanford 2014  
Healthcare operations and management, stochastic modeling, simulation
Zizhuo Wang  
Associate Professor  
PhD Stanford 2012  
Pricing, revenue management, optimization, internet economics

Shuzhong Zhang  
Professor  
PhD Erasmus 1991  
Nonlinear optimization, game theory, signal processing, risk management

Jean-Philippe Richard  
Professor  
PhD Georgia Tech 2002  
Mathematical optimization, healthcare, transportation, infrastructure

Karen Donohue  
Board of Overseers Professor of Operations and Management Science  
Carlson School of Management

Arthur Hill  
John and Nancy Lindahl Professor for Excellence in Business Education  
Carlson School of Management

Zhi-Quan Tom Luo  
Professor of Electrical and Computer Engineering  
College of Science and Engineering

Tony Haitao Cui  
Dean for Global Doctor of Business Administration  
Carlson School of Management

Affiliated FACULTY
"We thought Uber or Safe Boda vouchers would be an inexpensive, convenient way to get mothers and their near-infant children to places that administered vaccinations."
Can Sharing Scooters Save Lives?

Diana Negoescu links the sharing economy with improved vaccination rates.

Can the sharing economy make a big difference in child vaccination rates worldwide? That’s what ISyE Assistant Professor Diana Negoescu – and the Bill and Melinda Gates Foundation – want to find out.

Negoescu has long been interested in using industrial and systems engineering principles to improve healthcare. After meeting Nicole Basta (Epidemiology and Community Health) at new faculty orientation and co-supervising an honors thesis on public-private partnership in the emerging area of shared mobility with Professor Saif Benjaafar, she began wondering why vaccination rates in developing countries were often low despite numerous vaccination programs, most of which provided vaccinations free of charge. Basta had been involved in efforts to improve child vaccination rates in Kampala, Uganda, but was frustrated that no program was able to surpass a 80% vaccination rate for measles and other sometimes fatal diseases that affected thousands of children. Previous studies have suggested that transportation may be a key obstacle to increasing vaccination rates: Kampala has no public transportation system, and most residents are too poor to own a vehicle.

Most Ugandans, Negoescu learned, have cell-phones, and urban centers like Kampala have ride-sharing services like Uber and Safe Boda, a service that uses motorized bicycles, scooters, and motorcycles called "bodas" that are common in East African countries.

“Inspired by our previous work on public-private partnership in shared transportation, I thought Uber or Safe Boda vouchers would be an inexpensive, convenient way to get mothers and their near-infant children to places that administered vaccinations,” she recalls. “The rides themselves were not expensive, and there was no need for new communications, transportation, or medical infrastructure. It could be a way to partner with the local community and connect the dots for so many parents.”

Negoescu, along with her collaborators Basta and Benjaafar, pitched the idea to the Gates “Grand Challenges” program, which agreed to fund a Phase 1 feasibility study focused on measles vaccination. She, along with Professor Basta, Professor Benjaafar, and a group of healthcare professionals in Kampala, are gathering better data on transportation needs and barriers to vaccination. They are also building a mathematical model to simulate the transmission of measles in the Ugandan population. Once the data is complete, they will use the model to develop a cost-benefit analysis for using sharing-economy transportation vouchers to transport parents and children to vaccination clinics.

Negoescu hopes that a promising cost-benefit analysis will result in a Phase 2 grant from the Gates Foundation to fund an actual pilot program. “And if a pilot program is successful, we will have a solid basis for similar systems in other settings for many other vaccinations.”
Department Unveils New Analytics Program

ISyE’s new MS in Analytics gives students the tools and knowledge to drive a rapidly expanding field.

In Fall 2018, ISyE launched a new MS program in Analytics.

"Analytics is essentially a modern-day form of operations research," says Professor Bill Cooper, ISyE’s Director of Graduate Studies. "The ultimate goal is to make better decisions. What’s new – and evolving rapidly – are all the sophisticated mathematical and computing toolsets available to the field. And we’re at the point when it takes a significant investment in learning and training to master these tools and make them work together."

From industry’s point of view, the new program is much-needed. A 2016 McKinsey Global Institute report notes that demand for analytics employees already outstrips supply and that this imbalance may get worse – a reality that many of ISyE’s industry partners confirm.1

During the development of the new degree, one challenge was to clearly distinguish it from two other master’s-level programs at UMN: the Master’s in Business Analytics at the Carlson School of Management and the MS in Data Science, which is a joint program of the College of Science and Engineering, the College of Liberal Arts, and School of Public Health.

“These are both good programs, and we had no interest in drawing potential students away from them,” says Cooper. “So we had to ask ourselves: what does ISyE have that’s special?”

The answer, in short: a focus on decision-making.

“Our engineers analyze data sets and build and solve optimization models to help make decisions in an industry setting,” explains Cooper.

The core of the 30-credit, three-semester program is geared toward decision-making based on rigorous data analysis and mathematical optimization. Semester 1 includes a full course on regression analysis and

Another dedicated to optimization, a series "which lays a solid groundwork for analytics in an industry setting," says Cooper. "We’re focusing on skills and concepts necessary to turn data into useful insights and good decisions."

In Semester 2, students take courses on analytics and data-driven decision making (reflecting the focus of the program) and a course on either machine learning or data mining (reflecting key tools for identifying patterns in data that can improve decision making).

The core coursework in Semester 3 includes a full course on stochastic modeling and a capstone project modeled after ISyE’s successful senior design course (see Undergraduate Highlights for more on this course). In the capstone course, students will work on advanced analytics projects proposed by industry partners under the supervision of both an industry mentor and a faculty mentor. According to Cooper, the capstone project is a feature that makes the MS in Analytics degree stand out. "It is a great opportunity for students to work on real problems and to have close interactions with two mentors. The capstone is designed to provide invaluable practical experience."

Students will also participate in a new practice-focused seminar course that will mainly feature industry speakers describing cutting edge applications of analytics. This strong industry focus is intended to provide students with a broad understanding of various practical implementations of the analytics tools they learn in the program.

Cooper arranged for Daikin Applied, a major Twin Cities-based HVAC designer and manufacturer that has sponsored several undergraduate senior design projects in the past, to host the first capstone project. "We’ve had great interactions with Daikin," notes Cooper, "and Daikin was eager to have MS-level students. They’ve had a number of undergraduate senior design teams, but they had some analytics and optimization projects that could only be tackled by more advanced students."

The department expects the MS program to gradually grow to about 30 students per year. "There are plenty of Minnesota companies already connected to ISyE that would sponsor a graduate-level capstone project," says Cooper. He adds that ISyE has grown rapidly since becoming a department in 2012, "so we know how to accommodate new students and faculty."

What’s most exciting for Cooper is that the University of Minnesota will have an engineering-focused, graduate-level analytics program. "The state needs it, the university needs it, and the students need it."
QUESTION: What is the best way for a French public transit system to regain ridership lost to Uber-like services?

ANSWER: Throw the problem at a team of engineers, mathematicians, and industry experts and see what they come up with.

PARTICIPATING COMPANIES: C.H. Robinson, eBay, General Mills, HourCar, IBM, Mayo Clinic, Microsoft, and Transdev

That’s the basic idea behind the Industrial Mathematics Workshop, organized by ISyE professors Saif Benjaafar, Ankur Mani, and Zizhuo Wang. The event was hosted and partially funded by the National Science Foundation through the university’s Institute for Mathematics and its Applications (IMA) and co-sponsored by Microsoft and C.H. Robinson, an international logistics company headquartered in the Twin Cities. “We saw an opportunity to expand ISyE-related research and advance an innovative team-based approach to industry problems,” says Mani.

For three days in July 2017, around 100 industry professionals, academics, and graduate students gathered to kick-start research projects in four clusters: retail, transportation and logistics, sharing economy, and healthcare. Three keynote speakers from industry and academia were followed by a panel discussion for each cluster. Breakout sessions concluded the first two days at which industry participants presented specific problems facing their companies or field of work.

A subset of participants stayed on campus until mid-August to tackle the industry problems posed by industry participants. Following this in-residence period, groups maintained...
“We saw an opportunity to expand ISyE-related research and advance an innovative team-based approach to industry problems.”

close contact to continue working on their problems throughout the year. “The goal was to develop actionable results that are useful to the companies but that can also be published in a top journal or be a basis for a research proposal to a funding agency,” says Mani.

Importantly, Mani notes that the research groups were a mix of senior faculty, graduate students, junior faculty, and industry professionals. “This wasn’t just a training exercise, and it wasn’t just an academic exercise,” says Mani. “It was a way to pool resources in academia and industry to tackle complex problems.”

The groups reconvened at the University for a week in August 2018. It was an opportunity for intensive and uninterrupted interaction among team members. “We think that the models the teams developed will be adaptable to similar situations, perhaps even in different industries,” says Mani. As an example, results for the Transdev project are likely to be of relevance to many public transit agencies around the world.

Plans are already underway to prepare for a new edition of the workshop and clinic to be held in Summer 2019. “This is a unique way of bringing academia and industry together, and the results so far have been good for everyone,” says Mani. “We hope that this partnership model can be an inspiration for similar academia-industry partnerships around the country.”
Predicting Driver Absences to Minimize Service Disruption

The first project came from Metro Transit, the organization which manages nearly all Twin Cities public transportation – to the tune of 1000 buses and 1500 drivers that cover 130 daily routes over a 907 square mile area. Metro Transit’s problem: frequent and uncertain driver absences.

Metro Transit has full-time reserve drivers available daily, but seemingly random spikes in absences meant that overtime had to be used for routes on many days, leading to additional costs. Metro Transit, along with the University’s Office of Vice President for Research, co-sponsored the work of Qie He, graduate student Xiaochen Zhang, and ISyE senior Soniya Somani.

He and his team compiled absence and overtime data from previous years and started to see patterns. There were more absences during the school year, for example, and early morning routes needed reserves more often than daytime routes. The team created a machine-learning model to predict driver absences each day and an optimization model to recommend the number of reserves for the next day, which they then validated using more recent data.

“This is a great example of how theoretical research can improve our daily work,” says Eric Lind, manager of research and analytics at Metro Transit.

Optimizing Maintenance and Purchasing

Qie He’s second project came from Hennepin County – Minnesota’s largest county by population – and was a collaboration with fellow ISyE assistant professor Dan Mitchell. The county asked Mitchell and He to review its system for managing its fleet of over 250 pieces of mobile equipment. In particular, the county didn’t know if its policy of retiring snowplows after 10 years was optimal.

He and Mitchell focused on the county’s tandems, the trucks that are used for snowplowing and other regular duties. They developed models to predict the depreciation and maintenance costs of a truck based on 10 years’ historical data such as initial price, maintenance costs, resale price, and rental income. Then, they experimented with different purchase and resale policies to determine the best average cost per truck per year of service.

“Our program suggests that replacing these trucks every 11 years will result in a 3 percent savings in annual operating costs for the county,” says He, which would mean $2 million in savings over 10 years.

He and ISyE head of department Saif Benjaafar hope to engage with more municipalities. “It should be part of the department’s lifeblood,” says Benjaafar. “Municipal problems are fundamentally no different from the problems with which our industry partners present us every day. We can fulfill a real need, and students and faculty get to be engaged in real-world projects. It’s a win for everyone.”
"Municipal problems are fundamentally no different from the problems with which our industry partners present us every day."
"Studying cancer with the tools of industrial engineering makes perfect sense."
Fulbright for Cancer Research

Kevin Leder travels to Oslo to model cancer mutation

Cancer research is fairly common in engineering departments around the country, but still a rarity among industrial and systems engineers. For Professor Kevin Leder, though, studying cancer with the tools of industrial engineering makes perfect sense.

Leder’s interest in cancer research began when he was a post-doc at Memorial Sloan Kettering Cancer Center in New York City, where he learned that tumors are typically not genetically homogenous. “They’re like a wedding cake,” he says. “There’s a foundation of pre-cancerous cells, out of which come further mutated cancer cells, out of which come even further mutated cells.” Unlike a wedding cake, these cells are typically mixed up together, but careful analysis of mutations can potentially reveal how long a tumor has been growing.

Leder also learned that most cancer treatments target only one type of mutated cell. “This raised questions about treatment optimization,” he explains. “If we had a model of mutation development, could we better deliver treatments for tumors at different stages? Could we even use such models to better identify – and possibly eliminate – precancerous cells?”

Inspired by the success of previous mathematical models of leukemia development, Leder began to sketch out models that lay the groundwork for better treatment. He discovered, though, “that to make a valid recommendation about treatment, lots of patient data is necessary.”

As he was researching opportunities for his 2018-19 sabbatical, Leder found Professor Arnoldo Frigessi at the University of Oslo. Besides similar interest in mathematical models of cancer, Frigessi has data on a large cohort of multiple myeloma patients.

Leder plans to work with Frigessi to establish and test models that make sense of the patient myeloma data. He also hopes to develop ways to use the models to improve diagnosis and treatment of multiple myeloma and other types of cancer. The long-term goal, according to Leder, is “to develop a strong family of modeling tools that can be used to improve personalized medicine, especially in cancer treatment.”
Senior Kate Azar spent the 2017-2018 academic year working at HUSCO, a Wisconsin company that specializes in designing and manufacturing components for cars and off-highway vehicles. Azar worked in three different departments – quality, supply chain, and manufacturing – for four months each to gain a “big picture” of factors affecting product quality. For one project, she built an algorithm to generate biweekly reports on potential manufacturing issues to help HUSCO quality engineers. Why a rotational co-op instead of internship? “HUSCO’s rotational program allowed me to experience more and better narrow down what I’m interested in — it was like three internships in one,” says Azar. The co-op especially piqued her interest in data analytics, pushing her to take more analytics classes and start thinking about a master’s degree in the field.
UNDERGRADUATE
STUDENT HIGHLIGHTS

ISyE Undergraduate Class of 2018

Selection of Class of 2018
HIRING COMPANIES

3M  Accenture  Andersen  Boston Scientific  Deloitte  ExxonMobil  Graphic Packaging International  West Monroe Partners
UPS  U.S. Air Force  Cameron  Epic  GRACO  Rockwell Automation
IBM  allflex  Cognizant  EGAN  WELLS FARGO
**MISS MINNESOTA CONTESTANT**

Senior Rachel Eron won the title of “Miss Heartland” in a local Minnesota competition in March and then competed for Miss Minnesota in July with 24 other young women. She didn’t win, but she walked away with some scholarship money (including the organization’s STEM award) and “an incredible experience.” She has worked as a software engineer for Toshiba and a TA for a coding class, and she hopes to work in the surgical robotics field after graduation.

**INTERNSHIP DOWN UNDER**

Junior Emma O’Brien spent spring 2018 supplementing two courses with a hands-on engineering internship at Ramp RFID Solutions in Sydney, Australia. Although initially placed on the marketing team, O’Brien quickly sought out more IE-related work on a RFID bus tracker that was inconsistently reporting data. “I sorted through heaps of raw data to determine which systems were functioning improperly, then made a customer manual on the proper use of the software,” says O’Brien. She also says that she particularly liked the analytics portion of the project and intends to focus more on analytics in future studies.

**CO-OP MEDICAL DEVICES**

Senior Madison Schaefer is spending 2018 in the Heraeus Medical Components co-op program. The St. Paul company specializes in the production of implantable device cases and interventional cardiac devices, and Schaefer has worked on teams optimizing the effectiveness of tools in the manufacturing process and remedying manufacturing issues that caused low product yield. Participating in the co-op means adding an extra year to his undergraduate studies, but Schaefer says the time is well worth it: “I came into the co-op being terrified that I would screw up the tasks before me. Now, I’m confident that I can put my IE skills to use.” Schaefer also notes that the co-op has exposed him to new areas of IE and solidified his desire to stay in the IE field.

**RACING WITH THE SUN**

ISyE is sponsoring Eos II, the University of Minnesota’s all-solar multi-occupant vehicle that finished first in the 2018 Formula Sun Grand Prix and second in the 2018 American Solar Challenge. Eos II is also set to race in the 2019 Bridgestone World Solar Challenge in Australia. The ISyE team is led by Eric Sipila (ISyE ’20), Director of Operations and co-President for the Eos II team. The team also includes Manuel Fernandez (ISyE ’19) and Lyndon Hills (ISyE ’20).
IIE CHAPTER
The new University of Minnesota chapter of the Institute for Industrial and Systems Engineers (IIE) won the “Rookie of the Year” student group award from the College of Science and Engineering. The group hosted exploratory events, such as the Tech Elective Talk and the Senior Design Fair, where upperclassmen share their experiences with younger students. IIE also invited industry speakers to provide students with real-world contexts to use their ISyE problem-solving skills. Michaela Holmgren (ISyE’19), IIE’s Professional Development Officer, says the group plans to leverage its connection to the local professional chapter of IIE to expand its network of corporate contacts and eventually host a regional IIE conference.

NOBE NEWS
Senior ISyE student Matt Martell helped UMN’s National Organization for Business and Engineering (NOBE) chapter win the “Most Improved Student Group” award from the College of Science and Engineering. NOBE was recognized for its innovative Junior Board Member program, which helped drive attendance to an above-20 average at the several hour-long events the chapter hosts. For the 2018-19 academic year, Martell and the NOBE leadership team aim to double average attendance and offer a “What Is...?” series that will demystify key business and engineering topics such as cryptocurrency and master’s degree programs.

ISyE SPEAKER
COMMENCEMENT
ISyE major Steven Cherucheril was one of two student speakers out of over 1000 graduates at the College of Science and Engineering’s commencement ceremony in May. Cherucheril held multiple leadership positions within his fraternity, Beta Chi Theta, and the National Organization for Business and Engineering (NOBE). He completed internships with UPS and General Mills and just joined the technology-focused mergers and acquisitions group at West Monroe Partners. Cherucheril’s key piece of advice for his fellow graduates: “Always make the effort to give something a chance, and oftentimes it will pay dividends to you.”
## Senior CAPSTONE PROJECTS

<table>
<thead>
<tr>
<th>Company/Challenge</th>
<th>Outcomes</th>
</tr>
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</table>
| **DAIKIN APPLIED**                                                               | **Challenge:** Design a tool that determines order prices and manages factory capacity.  
**Outcomes:** Created a capacity tool that optimizes product inventory and profits based on capacity and demand. The team also detailed methods for developing a pricing tool for custom orders. |
<p>| <strong>DAIKIN APPLIED</strong>                                                               | <strong>Challenge:</strong> Increase accuracy of a predictive cost tool for custom HVAC units.                                                                 |
|                                                                                  | <strong>Outcomes:</strong> Reconstructed the predictive cost tool so that the average cost of an error was reduced to 0.01 percent of the actual manufacturing cost. |
| <strong>DAIKIN APPLIED</strong>                                                               | <strong>Challenge:</strong> Ensure patients who need wheelchairs are able to make it to appointments on time.                                                                 |
|                                                                                  | <strong>Outcomes:</strong> Developed a strategic plan to optimize the number, location, and repositioning of wheelchairs in the new HCMC Clinic and Specialty Center, potentially cutting wheelchair wait times to under five minutes. |
| <strong>GENERAL MILLS</strong>                                                                | <strong>Challenge:</strong> Prevent overstocking and understocking of baking products with shifting seasonal demands.                                                                 |
|                                                                                  | <strong>Outcomes:</strong> Generated regional and national forecasting models that would reduce the amount of error in product demand estimates by over seven percent. |
| <strong>GENERAL MILLS</strong>                                                                | <strong>Challenge:</strong> Reduce waste of unused GoGurt packing after seasonal redesigns.                                                                 |
|                                                                                  | <strong>Outcomes:</strong> Constructed a tool to identify required packaging stock and issued recommendations for managing random spikes in demand, potentially reducing product waste by over 90 percent. |
| <strong>UTC AEROSPACE SYSTEMS</strong>                                                        | <strong>Challenge:</strong> Reduce bottlenecks in the production of parts requiring the use of specialized ovens.                                                                                                |
|                                                                                  | <strong>Outcomes:</strong> Developed pseudocode based on an optimized model and clear instructions for scheduling oven loading sequences. The changes potentially reduce the amount of total production time for a single component by an entire week. |</p>
<table>
<thead>
<tr>
<th>ALL FLEX INC.</th>
<th>ALL FLEX INC.</th>
<th>BOSTON SCIENTIFIC CORPORATION</th>
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<tbody>
<tr>
<td><strong>Challenge:</strong></td>
<td><strong>Challenge:</strong></td>
<td><strong>Challenge:</strong></td>
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<tr>
<td>Reorganize production space to increase production rates and employee satisfaction.</td>
<td>Increase production capacity to accommodate growing demand.</td>
<td>Shrink amount of product waste and storage space used by work-in-process materials.</td>
</tr>
<tr>
<td><strong>Outcomes:</strong></td>
<td><strong>Outcomes:</strong></td>
<td><strong>Outcomes:</strong></td>
</tr>
<tr>
<td>Proposed a new production space layout, created a standard operating procedure for shared components, and issued a set of recommendations for future data collection, all of which have led to an increase in employee satisfaction with the production process.</td>
<td>Pinpointed problematic production areas and formulated recommendations to optimize the production process and integrate a new machine into the line, potentially increasing product output by 25 percent.</td>
<td>Issued recommendations to optimize the use of factory floor space, reroute the flow of raw and work-in-process materials on the floor, and reduce the amount of materials in process.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOSTON SCIENTIFIC CORPORATION</th>
<th>DESIGN READY CONTROLS</th>
<th>HERAEUS MEDICAL COMPONENTS</th>
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</thead>
<tbody>
<tr>
<td><strong>Challenge:</strong></td>
<td><strong>Challenge:</strong></td>
<td><strong>Challenge:</strong></td>
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<tr>
<td>Identify the cause of output variation in two lines of pacemaker batteries.</td>
<td>Reduce number of errors made in the production of custom control panels.</td>
<td>Provide rigorous analysis for the feasibility of a new product venture.</td>
</tr>
<tr>
<td><strong>Outcomes:</strong></td>
<td><strong>Outcomes:</strong></td>
<td><strong>Outcomes:</strong></td>
</tr>
<tr>
<td>Diagnosed key problem areas and produced a set of recommendations that would allow the manufacturing team to reduce the variation in the production process.</td>
<td>Interpreted the root cause of production errors, created a forecasting model of the likelihood and type of future errors, and detailed recommendations that would reduce these errors over 20 percent annually.</td>
<td>Constructed an evaluation tool to validate the proposed complex assembly process and presented an optimized layout of the assembly line, complete with an analysis of the expected relationship between cost and output.</td>
</tr>
</tbody>
</table>
How does a business model affect business outcomes? Fourth-year graduate student Behrooz Poughannad wants to bring fresh insight to this age-old question.

“Traditional models of revenue management, inventory, and game theory are constantly applied to traditional industries. But with new ventures like crowdfunding and the sharing economy, we’re just starting to guess at what will work,” says Pourghannad. “We need a lot more data and analysis.”

Poughannad’s achievements and experience have paved the way for his dissertation research and writing. After a BSc in Industrial Engineering from Islamic Azad University in Iran, a MA in Mathematics from Sabanci University in Turkey, and an MBA from Michigan, Poughannad enrolled at Minnesota “because the research interests of the department perfectly aligned with my interests, especially the work of Saif Benjaafar on the sharing economy and Guangwen Kong on crowdfunding.” Since then, he has published three papers (which garnered two awards: one from INFORMS and one from POMS), consulted for two Minnesota companies and interned at Mayo Clinic (see article on the next page).

Poughannad aims to graduate at the end of this year and continue in academia. “Every model that’s developed can lead to new and unexpected developments and applications, so there’s no shortage of exciting work to be done,” he says.

Student Spotlight

BEHROOZ POURGHANNAD
Modeling Hospital Infections

Anthony Zhenhuan Zhang, a fourth-year PhD student, recently led a project on healthcare-associated infections (HAIs) at the Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery at the Mayo Clinic. Approximately four percent of US inpatients (roughly 648,000) acquire one or more HAIs, almost half of which are considered preventable and all of which cost an $35 billion to $45 billion in direct healthcare costs each year. Zhang used 2012-2017 data from several hospitals to identify variables that correlate to higher rates of HAI contraction, then produced a model that predicts the likelihood of acquiring an HAI. The model will be used as an overall optimization plan for using limited hospital resources to help reduce costs for hospitals and patients as well as improve patient outcomes.

Pricing Analysis

Behrooz Pourghannad, a fourth-year PhD student, has been analyzing pricing and business models for Mayo Clinic. Providers in healthcare face an ever-changing array of payment plans as insurance companies and individuals look to maximize their dollars. Pourghannad’s pricing models build in patient outcomes so that Mayo can better understand – and communicate – the value of its comprehensive approach to health.
CONGRATULATIONS TO ISyE'S 2018 PH.D. GRADUATES!

LEFT-TO-RIGHT:  
Shaozhe Tao, Guiyun Feng, Xiaobo Li, Zizhuo Wang (ISyE Professor), Xiang Gao, Xiao Chen

NOT PICTURED:  
Junfeng Zhu, Shashank Goyal, Xiaoxu Tang

RECENT ACADEMIC PLACEMENTS

Xiao Alison Chen (2018)  
is a tenure-track professor at the University of New Hampshire.

Xiaobo Li (2018)  
is a tenure-track professor at the National University of Singapore.

Guiyun Feng (2018)  
will be a tenure-track professor at Singapore Management University in January 2019.

Rui David Chen (2016)  
is a tenure-track professor at the Chinese University of Hong Kong, Shenzhen.

Yan Liu (2015)  
is a tenure-track professor at Tianjin University, China.
Months before successfully defending her doctoral thesis on supply chain management and pricing models, Xiao Alison Chen already had a post-graduation position lined up as a tenure-track professor at the University of New Hampshire’s Peter T. Paul College of Business and Economics. At her new position in the Department of Decision Sciences, Chen will continue studying supply chains and pricing, but is also excited to branch into supply chain contract design and data science. For Chen, these topics are ripe for further research, due in large part to retailers recognizing that they can generate more profit through strategic pricing and inventory policies. Yet Chen is confident that academia, not industry, is the right path for her. “I’ve always liked to be in school and around other energetic and intelligent young people. I’ve also benefited from wonderful professors who have made a huge difference on my view of the subject, and they’ve inspired me to continue on this path. I want to be that professor for another generation of students.”
Professors Shuzhong Zhang and Zizhuo Wang are joining the new Institute of Data and Decision Analytics at the Chinese University of Hong Kong, Shenzhen (CUHK-Shenzhen) as part-time faculty. This is an expansion of the existing partnership between Minnesota and CUHK-Shenzhen, which centers on student and faculty exchanges, including a joint masters program where graduate students spend three years in CUHK-Shenzhen and two years at Minnesota to earn two degrees. Both professors will alternate working for a semester at Minnesota and CUHK-Shenzhen for three years.

CUHK-Shenzhen is “a natural choice” for Zhang, who was a faculty member at the main Hong Kong campus for a decade prior to coming to Minnesota. Zhang hopes to catalyze the expansion of data science programs at all levels at CUHK-Shenzhen, similar to the work he undertook as department head at ISyE over the past six years. For Zhang, returning to develop the Data and Decision Analytics program at Shenzhen is a smart opportunity to revitalize the connections built during his tenure in a way that will benefit both ISyE and the budding program in Shenzhen, including the formation of a joint Ph.D. and post-doc program.

Wang is also focused on developing the Institute at CUHK-Shenzhen and broadening the reach of the field at UMN. “China is a big market, so there is a lot of potential for the research to be applied there and to expose new groups of people to analytics,” he says. “Moreover, Chinese companies have become more aware of these tools” and are eager to make their decisions more scientific and data-based. As the owner of Cardinal Operations, an analytics startup in China, Wang’s expertise reaches beyond the academic realm into the entrepreneurial and will allow the program to build relationships with local companies. The result, he thinks, will be several new research opportunities at UMN.
Welcome to JEAN-PHILIPPE RICHARD

Jean-Philippe Richard breaks the mold of recent ISyE hires. Three of the past four — Sherwin Doroudi (2016), Dan Mitchell (2016), and Diana Negoescu (2014) — came to ISyE within a year of receiving a PhD. Richard is starting his 17th year as a professor after six years at Purdue and 10 years at the University of Florida.

Richard’s experience and stature is precisely why the department pursued him. “He is a star researcher, a dedicated teacher, and an inspiring academic leader,” says Saif Benjaafar, ISyE Department Head. “His leadership will be instrumental as we continue to grow, broaden our research footprint, and engage with outside organizations.”

Noting Richard’s extensive record of research accomplishments, Benjaafar also expects that Richard will “solidify UMN’s position as a leading program for optimization and its applications.” Richard’s work, which primarily focuses on nonlinear mixed-integer optimization problems, has been applied to railroads, various supply chains, water distribution, and healthcare.

For Richard, UMN presents an exciting opportunity. “Minnesota’s ISyE is young, diverse, conducting really interesting research, very much teaching-focused, and has a great forward trajectory. And it’s part of a strong, interdisciplinary College of Science and Engineering. I expect to contribute to the department’s continued growth and excellence.”

CONGRATULATIONS TO...

Saif Benjaafar for being named Editor-in-Chief of the INFORMS journal Service Science and for receiving the INFORMS Distinguished Service Award.

Qie He for receiving a grant from the Argonne National Laboratory to develop fast routing algorithms for power system restoration after natural disasters.

Kevin Leder for receiving a Fulbright fellowship to develop models of cancer metastasis at the University of Oslo in Norway (see page 17).

Ankur Mani for receiving a grant from the University’s Digital Technology Center to study leveraging social influence for improved health and wellness.

Lisa Miller for being promoted from Associate Teaching Professor to Teaching Professor.

Diana Negoescu for receiving a Grand Challenge Award from the Bill and Melinda Gates Foundation to study the feasibility of using ride-sharing services to improve vaccination rates in Kampala, Uganda (see page 9).

Zizhuo Wang for being promoted to the rank of Associate Professor with tenure and for receiving the 2017 Adobe Digital Marketing Research Award.
In Memoriam

Sant Ram Arora

With deep sadness we received the news that Professor Emeritus Sant Ram Arora passed away on Tuesday, April 10, 2018. Professor Arora served on the faculty of the Departments of Mechanical Engineering and Industrial & Systems Engineering at the University of Minnesota for 49 years.

Professor Arora was an integral part of the Industrial Engineering program from its early years as a division of Mechanical Engineering. He made several important research contributions to the field of optimization and to the development of computer-aided decision support systems. His expertise has been nationally and internationally recognized through his many publications and as a member of several industrial engineering professional societies. Over his career, Professor Arora advised over 70 graduate students, including 15 PhD students who have gone on to successful careers in academia and industry.

Welcome to Hongna Bystrom

ISyE’s new administrator comes with a wealth of experience in higher ed management. After receiving a BA in International Business and English in China, she worked in industry for two years before joining the University of Northwestern in the Twin Cities, where she remained for 12 years as an administrator while also earning a BS in Business Administration and a MA in Organizational Leadership. Since 2015, she has been chief administrator for two departments in UMN’s College of Liberal Arts, where she was active in several administrative task forces and organizations and won the Outstanding Service Award in 2017.
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First Alumni Get-Together

Good times and good beer were flowing at the first-ever ISyE Alumni get-together. The venue was 56 Brewing, a micro-brewery and taproom in northeast Minneapolis that is completely owned and operated by UMN alumni. The tour was amazing, the conversation was great, and the beer was better than both.

October 4th
5:30–7 pm
Summit Brewing Co.
910 Montreal Circle
St. Paul, MN 5501

Yes, another brewery tour!
Yes, more beer tasting!
Great conversation and general good times are almost guaranteed. Bonus for dog-lovers: leashed, well-behaved dogs are welcome on the Summit patio.

z.umn.edu/isyefall2018
Jennifer Clarke at 612-626-9354.
Alumni Spotlight
MONDHER BEN HAMIDA
Industrial Engineering and Operations Research MS, 1997

WORKS AT APPLE
Worldwide BPR Product Operations Team

What I Do:
My team ensures that Apple’s manufacturing partners are integrated into Apple’s supply chain. We assess each partner’s operational and technical capabilities and figure out how to merge their business operations with Apple’s while constantly looking for ways to improve and evolve the working model.

Why Minnesota:
An undergraduate professor in Tunisia knew Saif Benjaafar, so I ended up there as an intern. I returned as an MS student because I liked the program and they gave me an assistantship. I love Minnesota. If my first job had been with 3M or some other company in the Twin Cities, I might still be there now.

My ISyE Degree...
is invaluable. It refined all that I had learned as an undergraduate and introduced me to much more. Studying green operations has turned out to be especially valuable. Every day, I’m using multiple tools from my ISyE toolbox.
### Recent Seminars

**FALL 2017**

**September 6th**  
Joseph Chow  
NYU  
Models to Operate and Evaluate Mobility-as-a-Service

**September 13th**  
Johnathan Helm  
Arizona State University  
A New Operational Framework for Reducing Hospital Readmissions

**September 27th**  
Jim Dai  
Cornell University  
Stein’s Method for Steady-State Approximations, Error Bounds and Engineering Solutions

**October 11th**  
Moshe Haviv  
Hebrew University of Jerusalem  
Regulating the Arrival Process to a Queue

**October 18th**  
Mark Broadie  
Columbia University  
Golf Analytics

**November 15th**  
Candace Yano  
University of California, Berkeley  
Store Brand Positioning and Pricing in the Presence of Retail Competition

**December 13th**  
Sharad Goel  
Stanford University  
Algorithmic Decision Making and the Cost of Fairness

**SPRING 2018**

**February 28th**  
Ivo Adan  
Eindhoven University of Technology  
Call Center Model with Heterogeneous Reneging Customers

**March 21st**  
De Liu  
University of Minnesota, Carlson School of Management  
Dynamic Ascending Clock Auction for Privacy-Preserving Assignment

**April 4th**  
Marco Scarsini  
Department of Economics and Finance, LUISS, Rome  
When is Selfish Routing Bad? The Price of Anarchy in Light and Heavy Traffic

**April 11th**  
Joshua Reed  
NYU Stern School of Business  
Large-Scale Bundle Size Pricing: A Theoretical Analysis

**April 18th**  
Ohad Perry  
Northwestern University  
Queueing Models for Inpatient Wards

**April 25th**  
Anton Kleywegt  
Georgia Tech  
Distributionally Robust Stochastic Optimization with Wasserstein Distance

**September 6th**  
Joseph Chow  
NYU  
Models to Operate and Evaluate Mobility-as-a-Service
GIVE TO THE MAX DAY
NOVEMBER 15, 2018

Annual gifts to ISyE are deeply appreciated! Please consider a gift of any amount to ISyE this fall. Your generosity will help us support more students, develop educational programs, strengthen research, and enhance community engagement and outreach.

FOR MORE INFORMATION:
isy.e.umn.edu/giving

Whether you are a recent graduate, an industry partner, or a senior alum, your gift makes a difference!