



ORIE

Magazine

Newsletter
Fall 2021

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A group of five diverse students (three women and two men) are standing on a set of stairs in front of a modern building with large glass windows. They are all smiling and looking towards the camera. The student in the center foreground is a woman with long brown hair wearing a maroon sweater and blue jeans. To her left is a woman with long dark hair wearing a denim jacket over a white and black striped turtleneck. To her right is a man with glasses wearing a black jacket over a dark shirt and tie. Further back are a woman with long dark hair in a blue sweater and a man with short blonde hair in a red and blue plaid shirt and tan pants.

**ORIE STUDENTS
MAKING THE
MOST OF THEIR
RESEARCH
OPPORTUNITIES**

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MESSAGE FROM THE DIRECTOR

Over the summer we were all looking forward to a return to normalcy. Virtually all of the students and faculty were already vaccinated and raring to get back in the classroom. Delta had other ideas. The quick and partial pivot back to COVID-19 mitigation measures was a bummer to say the least.

With that being said, the ORIE pandemic spread and classroom scheduling teams were at the ready and swung back into action. While the semester did not feel normal by pre-pandemic standards, it was certainly a much more relaxed environment than the previous year.

Relaxed? Well as much as one can relax into developing mathematical models equipped with both traditional and innovative optimization techniques in big data algorithms. The “hallway buzz” that I mentioned was missing in my last update is back, and it feels fantastic!

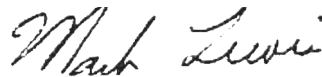
In June, we were very happy to have Dr. Mark Eisner be named the college’s first emeritus senior lecturer. Cornell does not have a history of providing the emeritus stature to non-tenure track faculty, but when I heard it was a possibility, there was no other choice but to bestow on Dr. Eisner this honor. In his more than 50 years of connections to the school (as a student, faculty member, alum and then as the former director of our Master of Engineering program), Mark has exemplified the kind of dedication that eight former directors raved about.

Omar El Housni, who for the last couple of years had been a visiting assistant professor at Cornell Tech, has agreed to join us as a tenure track assistant professor in January. This brings the number of ORIE faculty at Cornell Tech to five (up from three a few years ago). We are planning to continue to grow that number over the next couple of years, but even at five they are starting to feel more like

a cohesive unit. Assistant Professors Siddhartha Banerjee, Yudong Chen and Jamol Pender were promoted to Associate Professors with indefinite tenure in July. The research domains of these three represent broad areas of stochastic modeling, dynamic control and modern statistics. They are adept at both the development of theory and the application of data driven decision making methodologies like machine learning and reinforcement learning. In them (and others of their vintage) you can see that the future of the department is in good hands.

Lastly, I would like to say that it is the dedicated faculty, staff, students and alums who keep ORIE a vibrant research and learning community. Each day I marvel at how lucky I am to lead such and amazing group.

Warm regards,



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ON THE COVER

Seniors (from left to right) Jody Zhu, Ceren Konak, Bonnie Akhavan, Christopher Archer and Willem von Osselaer have been very involved in research thanks to the ORIE Undergraduate Society.

THE ORIE MISSION

The School of Operations Research and Information Engineering’s mission is to host research programs, a full spectrum of educational programs, and industry outreach activities spanning its eponymous domain.

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When Cornell University's ORIE Undergraduate Society (OUS) held a research night this fall, the student-run

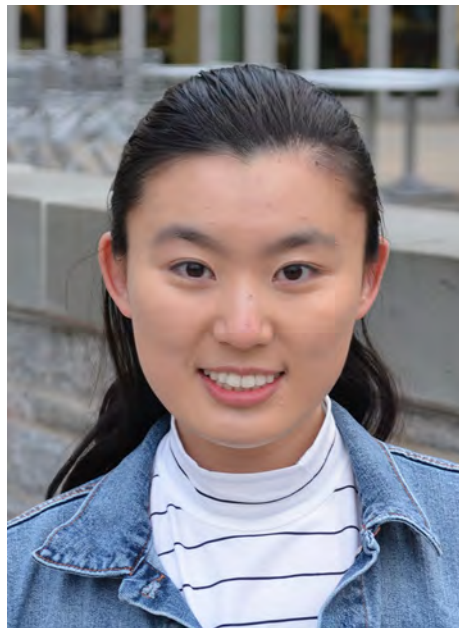
event met with an enthusiastic response. "We had a huge turnout," said member Jody Zhu '22. "After talking to some underclassmen, I realized they were feeling the same way I did two years ago when I first went looking for research opportunities — hungry for knowledge and wanting hands-on experience."

It is a need the School of Operations Research and Information Engineering is working hard to meet, says Associate Professor David Goldberg, the OUS faculty advisor. Over the past summer, he put out a call to students to revive the group, which had become less active during the pandemic, with a strong focus on research. "I thought that people may be feeling a little isolated, and this would be a great way to bring them together," he explained.

Willem van Osselaer '22, who had changed his major just as classes moved online and had yet to meet his fellow ORIE students, was among dozens of students happy to take him up on the offer. Van Osselaer, Zhu and a handful of other students are currently working with faculty advisor David Shmoys, the Laibe/Acheson Professor of Business Management and Leadership Studies, to help the Cornell Registrar better schedule exams to minimize the number of students with conflicts. "Research has been a great way to get to know not only ORIE professors but also other ORIE students," van Osselaer said. "It has been a joy to work together on something that impacts the Cornell student community so directly."

The project is one of six on offer through the society, adding research opportunities with such partners as CVS, General Motors and the Enfield Food Pantry to those traditionally available directly

UNDERGRADUATE RESEARCH INITIATIVE OPENS DOORS



Jody Zhu '22

through faculty members for academic credit or pay. Between one and two dozen students enroll in the ORIE Project course (ORIE 4999) each semester as they conduct independent research with an advisor, while typically up to four ORIE students per year receive grant support for wages or project expenses from the college-wide Engineering Learning Initiatives Student Grant Program (ELI). (The Meyer Gross '58 Scholar in Undergraduate Research Fund is earmarked specifically for one or two ORIE undergraduates annually.)

Bonnie Akhavan '22, for one, is working on the Cornell COVID-19 modeling team for academic credit. There she joins Eleanor and Howard Morgan Professor of Engineering Peter Frazier, Charles W. Lake, Jr. Chair in Productivity Shane Henderson, Shmoys, five Ph.D. students and her friend Henry



Willem van Osselaer '22

Robbins '22 in using data science to study the spread of COVID-19 on Cornell's Ithaca campus and the impact of various interventions on public health. "Doing research on my team is a very empowering experience," said Akhavan, who has been running a simulation developed by two of the doctoral students to determine how different levels of masking could impact the number of infections seen in a semester. "The faculty in our group have been incredibly supportive and given me so many opportunities to take charge of my work and contribute meaningfully to the avenues that we're trying to research."

Thanks to this first research experience, Akhavan is now considering extending her plans for a master's degree into a Ph.D. — like Zhu, who has decided to pursue a doctoral degree after greatly enjoying the

ORIE FEATURE

challenges of several semesters of research. In addition to the OUS project with the Cornell Registrar, she has also worked with a team around Shmoys on optimizing seating assignments with social distancing constraints and is part of a small group of undergrads helping Henderson code up a library of test problems on which to run and improve a variety of solvers.

For Henderson, the benefits of the undergraduate research relationship go well beyond the fact that students are taking on a time-intensive task that may result in solvers with a “huge” scope of application. “It’s fun getting to know some of the students who are just terrific personalities, people with incredible potential, whom we can help on to the next stage of their careers,” he said. Getting to know them as individuals outside of the classroom also makes it a lot easier to write personalized and genuine letters of recommendation. “You can view them as a full-dimensional person.”

Students, on the other hand, find that engaging in research builds bridges—to their professors and peers, to careers in academia or industry, and between the classroom and real-world applications. Hoping to understand how theory can be leveraged to make a practical impact, Christopher Archer ’22 first participated in Associate Professor Jamol Pender’s research with the Ithaca Police Department as a freshman. Two years later, he worked with his advisor, Associate Professor Siddhartha Banerjee and graduate student Sean Sinclair, Ph.D. ’23, on developing a reinforcement learning environment for fair online resource allocation, motivated by the challenges that face the Food Bank of the Southern Tier. (Both experiences were supported by the Hunter Rawlings Presidential Research Scholarship.)

“My classwork gave me more theoretical grounding for the topics that surfaced in my research, and my research



Christopher Archer '22

Summer Hackathon Experience a Positive One for ORIE Senior

ORIE major Ceren Konak ’22 is part of the winning team of the Anthem AI Substance Use Disorder and Whole Health of the Person Hackathon that took place over the course of four weeks in May and June of this year. Based at Penn State, where Konak was taking a summer course, the multidisciplinary group of four students tackled a provided patient data set to identify risk factors related to substance use and conditions indicative of underlying substance abuse. “My particular role was identifying and optimizing the rule set used in our solution,” said Konak, who also held the final presentation.

Drawing on machine learning algorithms and statistical techniques and with support from Anthem data scientists and experts, the team created two risk indices, the Opioid Misuse Index (OMI) and Substance Abuse Index (SAI), which they implemented into an app. Based on a patient’s medical history or responses to a simple questionnaire, the app presents medical professionals with the likelihood that an individual may develop a substance abuse disorder. “This can be useful to know before prescribing medications to patients,” Konak explained. The solution was recognized with a \$10,000 prize, to be split among the team members.



Ceren Konak '22

ORIE FEATURE

gave me topics that motivated my study, including which classes to take and what to focus a project on,” Archer said. “I got a huge confidence boost. I know now that, with enough time, I can solve real-world problems and convey the correctness of my solution using math and data science.”

Pender, whose own undergraduate research experiences helped steer him onto the academic path, points out that, by pursuing research, students also hone important independent critical thinking and computational skills, as well as their abilities in oral and written communication. Add to that the chance for students to practice leadership by directly managing relationships with industrial partners through OUS projects, and undergraduate research in ORIE “really provides a holistic experience to close the loop on what they learned in the classroom,” said Goldberg.

For Vishruth Rajinikanth '22, understanding how to speak with industry partners was a big takeaway from working on two project teams—one optimizing the CVS supply chain, the other examining questions in pricing and advertising at GM. “It is just as crucial to communicate the

work we have done as it is to do the work itself,” he concluded. “Making interpretable conclusions that decision makers can ultimately use is a skill in itself. For me this research experience has been invaluable.”

Goldberg believes alumni can play a key role in creating such opportunities. “I think of it as an ORIE ecosystem, where alumni who were undergraduates connect to current students and help mentor them on their path,” he said. “Then those students will themselves become alumni. You get this virtuous cycle.” He hopes to host alumni for virtual or in-person chats with groups of undergraduates and plans to launch a more formal mentoring network through OUS in the coming months.

Other forms of support are just as welcome. “For the undergraduate society and these research initiatives to reach their fullest potential, we do need funds to not only staff and run all these projects, but also hold events for students to showcase their work, send students to conferences, and bring in speakers from industry and academia,” Goldberg said. Pender adds that anyone wanting to back undergraduate research may also consider contributing

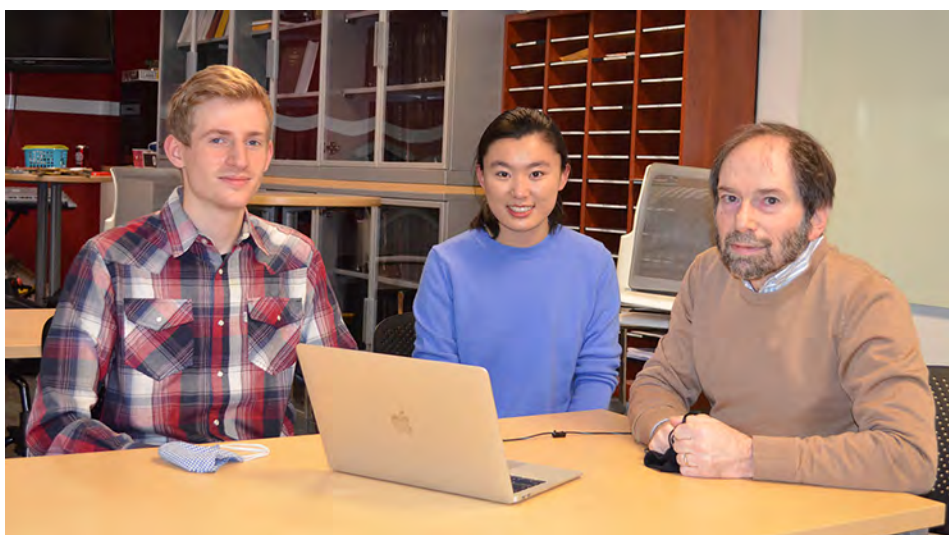


Bonnie Akhavan '22

to ELI, specific professors who provide opportunities to students or the ORIE department. (A generous gift from an alumnus, for example, flowed into the ORIE Fund for Innovation in Undergraduate Research last year.)

As students’ response to the OUS research night proved, they are eager—and grateful—for the increasing avenues to expand their learning and skill sets through undergraduate research. “I applaud the efforts to give more students the opportunity to participate,” Zhu said. “Before, cold-emailing professors seemed like the only way to get involved, so it’s exciting to see ORIE breaking down barriers and opening doors.”

By Olivia M. Hall



Willem van Osselaer '22, Jody Zhu '22 and Professor David Shmoys have worked to help the Cornell Registrar better schedule exams to minimize the number of students with conflicts.

Zoe Wang, who received her Master of Engineering degree in financial engineering in December 2020, published a paper in the summer 2021 issue of *The Journal of Financial Data Science*, arguably the top quant publication.

Wang's paper, titled "Deep Q-Learning for Trading Cryptocurrency" was co-authored with Alex Fleiss, the CEO of Rebellion Research in New York City and Yu-Chien (Calvin) Ma, a Rutgers Business School graduate.

"As a result of this article being published, our hope is to get more fellow Cornell students to become interested in the digital currency/quantitative finance world," said Wang, who interned at Rebellion Research during the summer of 2020. "This article could also provide some great insights to them, as cryptocurrencies are getting increasing attention from the big institutions worldwide."

"The potential for applying various forms of both deep learning and reinforcement learning to trading cryptocurrencies is very exciting," Fleiss said. "We have demonstrated an ability to create outsized returns and alpha in the alternative currency space and our research should be a building block for future work in the space. As always I am grateful for the support of Cornell Financial Engineering and (Cornell Financial Engineering Manhattan Director) Victoria Averbukh."

The article sets forth a framework for deep reinforcement learning as applied to trading cryptocurrencies. Specifically, the authors adopt Q-Learning, which is a model-free reinforcement learning algorithm, to implement a deep neural network to approximate the best possible states and actions to take in the cryptocurrency market. Bitcoin, Ethereum, and Litecoin were selected as representatives to test the model. The Deep Q trading agent generated an average portfolio return of 65.98%, although it showed extreme volatility over the 2,000 runs. Despite the high volatility of deep reinforcement learning, the experiment demonstrates that it has exceptionally high potential to be employed and provides a solid foundation on which to build further research.

The key findings of the study were:

- The authors use deep neural networks to create a Deep Q-Learning trading agent that approximates the best actions to take based on rewards to maximize returns from trading the three cryptocurrencies with the largest market capitalization.
- The Deep Q-Learning agent generates a return of nearly 66% on average over the course of

CFEM ALUM ZOE WANG PUBLISHED IN TOP QUANT JOURNAL



Zoe Wang '20, who received her Master of Engineering degree in financial engineering in December 2020, published a paper in the summer 2021 issue of The Journal of Financial Data Science.

2,000 episodes; however, the returns do exhibit a large standard deviation given the highly volatile nature of the cryptocurrencies.

- The authors introduce a framework on which future deep reinforcement learning and rewards-based trading agents can be built and improved.

Following her graduation from Cornell, Wang took a position as an analyst with Atlas Capital Team L.P. in New York City.

ALUMNI SPOTLIGHT

Having completed his Ph.D. in 2021, Lijun Ding is currently a Postdoctoral Scholar in the Department of Mathematics at the University of Washington in Seattle. A native of Hangzhou, Zhejiang, China, Ding graduated with an M.S. in statistics from the University of Chicago and received a B.S. in mathematics and economics from the Hong Kong University of Science and Technology in 2014.

What motivated you to pursue your Ph.D. at Cornell?

During my graduate study in statistics at UChicago, I got a few chances to take classes on and to do research in optimization. I found it very interesting and hoped I could do something in the intersection of optimization and statistics. In my Ph.D. application search, I found that ORIE at Cornell fit my interest best as there are many world-class researchers who are working on both fields.

What does being a Cornellian mean to you?

To be honest, I have never thought about this question during my Ph.D. study. Thinking back about my five years in Ithaca, I think being a Cornellian means always being curious and willing to spend time on something that may not produce immediate gain.

Who inspired/influenced you during your time at Cornell?

It is hard to determine a single person that affects me most. I want to name three people: James Renegar, Yudong Chen, and Madeleine Udell. Jim gave me lots of advice and he was always available to hear about my research and situation before the epidemic, even though he is not my advisor. I am also deeply impressed by his honest and humble character. I am very thankful to my advisor Yudong, who provided me the most financial support, but also let me search for my own interests. He is also willing to hear my unprepared presentations and premature ideas, and is quite sharp in giving feedback. Talking with Madeleine is always fun and I could feel her energy in doing research and searching for new ideas. I am also surprised and inspired by her many ways in dealing with daily life issues.

What will you miss the most about Cornell?

I guess I will miss the people and many trails, which I walked frequently during my final year.

What surprised you most about your Cornell experience?

The ORIE department is very friendly, caring, and helpful. I got many chances to collaborate with my fellow students.

Q & A WITH LIJUN DING

What accomplishment as a Cornell student makes you most proud?

My student paper prize 2019 of INFORMS Optimization Society makes me most proud. Though I really did not expect I could get the prize.

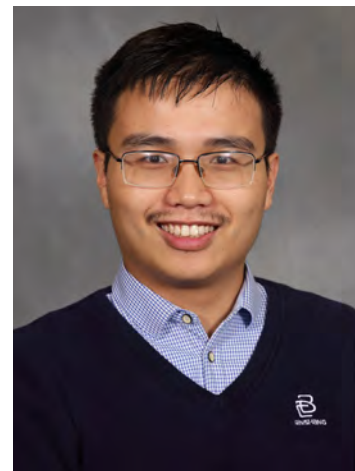
What moments—big or small—made your Cornell experience special?

I think it would be the project presentation on predictions of March Madness for the course ORIE 6125, computational method in OR. Instead of just the prediction, we actually produced an interactive website. The user can look at the prediction of a specific team that they are interested in. One could also see the predicted tournament results in a singular plot. I guess the most memorable thing is that we presented it to all of the ORIE Ph.D. students in the Ph.D. lounge and I could feel the welcoming and friendly atmosphere at that time.

Fun Facts

I am actually the first person in my family (including my father's side and my mother's side) to pursue a Ph.D. My parents, like most Chinese people, are from the countryside. Due to their hard work, the education they received, and the development in China, my parents are now able to have a much better life than before. I am very grateful for their support of my studies and their continued care during my time studying abroad.

I tried to practice my Cantonese during my study at Cornell. I talked to Venus Lo Ph.D. '19 and Michael Choi Ph.D. '17 in Cantonese, though in the end the talk usually turned into English or Mandarin as I cannot really understand their Cantonese. Yudong is actually from Canton, but he kind of refused to practice Cantonese with me as he cannot understand my Cantonese. So we most of the time talked in Mandarin.



First-year ORIE Ph.D. student Yuheng Wang has been awarded the Professor Robert E. Bechhofer Fellowship, ORIE Director Mark E. Lewis announced today.

"This fellowship is made possible through the generosity of an anonymous alum," said Lewis, the Maxwell M. Upson Professor of Engineering. "The alum explained that Professor Bechhofer had an amazing impact on his life and the lives of all of his students. Recognizing that impact was his way of giving back to the ORIE community."

Wang graduated from Columbia University this past spring with a bachelor of science in operations research. He completed a 3+2 program, also receiving a bachelor's degree in mathematics from Carleton College of Minnesota.

"It is my great honor to receive the Professor Robert E. Bechhofer Fellowship," Wang said. "I am very grateful for the support this fellowship will provide me in my Ph.D. studies at Cornell."

Wang chose Cornell ORIE for its "fantastic resources, community, and professors, which I believe can help me build a solid foundation in operations research."

"I previously did some research on the spread of COVID-19 under the guidance of Professor Vishal Misra at Columbia," said Wang. "I hope to further my study at Cornell and focus more on problems that can make an impact on real life. I am now interested in sequential decision-making and stochastic optimization, where Cornell has abundant resources to help me delve into these areas."

The Bechhofer Fellowship honors the legacy of long-time ORIE Professor Robert E. Bechhofer, who was a member of the department faculty from 1953-89. He served as Chair of the Department of Operations

YUHENG WANG RECEIVES BECHHOFFER FELLOWSHIP



Yuheng Wang

Research from 1967-75 and Director of the newly-created School of Operations Research and Industrial Engineering from 1975-77.

When he looks back at his final year at Cornell University, Anders Wikum will have plenty for which to be proud. Among those fond memories is being recognized as a 2021 Merrill Presidential Scholar. Wikum earned his B.S. in operations research and engineering from Cornell this past May.

Anders was recruited by ORIE's David B. Shmoys, the Laibe/Acheson Professor of Business Management and Leadership Studies, to Cornell's roster implementation team in summer 2020 and played a major role in building the university's fall 2020 and spring 2021 course rosters.

"Anders is an incredible all-around extraordinary student," say Shmoys, "He is a creative problem-solver, a great system builder, an intensively hard worker, and a modestly unassuming individual to boot. We were amazingly fortunate to be able to recruit him to the roster implementation team. And the research that we have been working on during this past academic year shows that his talents span from practice to theory."

A native of Mainesville, Ohio, Wikum was one of 37 outstanding seniors recognized as 2021 Merrill Presidential Scholars, who are selected by their college deans based on their extraordinary academic achievement, strong leadership and potential to contribute to society. As part of the program, the scholars — who are in the top 1% of their class — share the honor with a high school teacher and a Cornell faculty member who has inspired them and contributed to their academic development.

Outside of his scheduling work for the university, Anders was a subteam lead for Cornell Data Science and has been involved in research with various ORIE faculty. He co-authored a paper on wait-time estimation in queues with Associate Professor Jamol Pender, which received ELI summer research grant funding and was published in the proceedings of the 2019 Winter Simulation Conference, and more recently he has explored combinatorial optimization through Ph.D.-level algorithms courses and algorithms research with Professor Shmoys.

ORIE'S ANDERS WIKUM NAMED **MERRILL** **PRESIDENTIAL SCHOLAR**



Anders Wikum

In addition to Professor Shmoys, Wikum also honored Lynn Brant from the mathematics department at Kings High School in Kings Mills, Ohio.

Following graduation, Anders joined QuantumBlack, a specialized data analytics group within McKinsey & Company, in Boston, Mass.

A team of Cornell undergraduates led by rising senior Qihan (Jody) Zhu received first-place in the Institute of Industrial & Systems Engineers (IISE) Operations Research Division 2021 Undergraduate Research Dissemination Award, announced at the annual IISE conference, which was held virtually due to the COVID-19 pandemic.

Zhu, who is studying both operations research and engineering and computer science, was working on updating ENGR1 1101: Engineering Applications of Operations Research course last summer under the direction of David B. Shmoys, the Laibe/Acheson Professor of Business Management and Leadership Studies. Shmoys decided that the problem of determining the maximum number of seats usable with social-distancing constraints would make a timely new lab exercise as part of this ongoing redesign effort. Zhu and Ph.D. student Sander Aarts began work on the lab, using computer vision to identify chairs from architectural drawings of a classroom combined with a state-of-the-art optimization model. They had the basic workings of a tool that could automate this

ORIE TEAM LED BY JODY ZHU TAKES FIRST PLACE IN IISE UNDERGRADUATE RESEARCH COMPETITION

process when the Office of the University Architect (OUA) reported to Shmoys that their own approach to providing drawings for Cornell's reopening for fall 2020 was proceeding slower than anticipated. Undergraduate students Kyle K. Greenburg and Trey Hensel, overseen by Samuel Gutekunst Ph.D. '20, were brought on to work with OUA and helped Cornell replan all classrooms to be used in the fall, thereby increasing the capacity by hundreds of seats across campus.

The team's work was outlined in the paper, "An automated tool for optimal classroom seating assignment with social distancing components," by Kyle K. Greenberg, Trey Hensel, Zhu, Aarts, Gutekunst and Shmoys.

"It was a great team effort — although Jody and Sander had set up the initial framework, the full group helped refine the user interface so that it could then be used at



Qihan (Jody) Zhu

other institutions," said Shmoys.

"We built a tool that takes in an image of a floor plan and returns the floor plan with the optimal solution, seats to be used, marked," said Zhu. "I would say our biggest accomplishment, and one that the judges at the conference liked, was how we automated most of the process in a tool that anyone can access, use, and extend."

The Cornell ORIE paper topped the other two finalists — Mercer University and Purdue/Virginia Tech. Iowa State University and the Rochester Institute of Technology sponsor the award.



Each year, Professor of Practice and Director of ORIE's Master of Engineering program Kathryn Caggiano gets to stand in front of a group of graduating students and their families to announce that year's M.Eng. award winners. While the May 2021 graduation ceremony was held virtually, Professor Caggiano was still able to honor the winning teams.

The Silent Hoist and Crane Material Handling Prize was originally established in 1950 for the purpose of "stimulating the thinking of engineering students with aptitude or special interest in the Art and Science of Materials Handling."

"In the 70-plus years that have elapsed since then, companies have evolved and expanded, and the portfolio of 'materials' that require careful handling in most organizations has crossed over from the physical realm to the digital one," said Caggiano. "On behalf of the original Silent Hoist and Crane Company, we now award this Prize annually to recognize exceptional project work related to the handling of physical or digital materials.

"This year, we were delighted to be able to recognize three Master of Engineering project teams from the School of Operations Research and Information Engineering for first-, second-, and third-place honors," Caggiano said.

The first-place prize was awarded to the team working with Pitney Bowes on the project entitled "IND Facility In-and-Out Optimization." The winning team of Yixiao He, Xiaoxiang Ma, Yuke Wu, and Jiaqi Zhang was advised by Assistant Professor Damek Davis.

Second place went to the M.Eng. team working with Booz Allen Hamilton on the project entitled "Revamping Recruiting through Data Analytics." The team consisting of Aliyah Geer, Max de Ledebur, Jin Lee, and Jaylen Keith was advised by Eric Gentsch, a lecturer in ORIE.

Third place was awarded to the team working with FMCG Direct on the project entitled "Optimizing Cash Bonus Offers for Financial Institutions." The team of Jiehao Li, Muyuan Liu, Qianqian Wu, and Guorui Xu was advised by former ORIE lecturer Qiaomin Xie.

Following the announcement of the Silent Hoist & Crane awards, Caggiano honored the Andrew Schultz Jr. Award

ORIE MENG STUDENTS RECEIVE AWARDS AT VIRTUAL COMMENCEMENT

recipients.

"Each year, in Andrew Schultz, Jr.'s honor, we recognize the most outstanding Master of Engineering students, as evidenced not only by their high academic achievement, but also by their exceptional teamwork, their willingness to encourage others, and their demonstrated potential to become exemplary professional citizens," said Caggiano.

"This year we are very proud to recognize four outstanding M.Eng. students—two December 2020 graduates in Silvia Ruiz and Yiwei Zhang and two May 2021 graduates in Jin Gyu Lee and Brittany Steneke," Caggiano said. "Each has contributed to their M.Eng. class in ways that make us exceedingly proud to be able to call them Cornellians."

The late Andrew Schultz, Jr., received his B.S. and Ph.D. degrees from Cornell. He joined the faculty in 1951, and became the head of our predecessor department, the Industrial Engineering and Administration Department. Andrew Schultz served as Dean of the College of Engineering from 1963 to 1972, and he was a strong supporter of the Master of Engineering program.



Operations Research &
Information Engineering

Silent Hoist and Crane Materials Handling Prize

Sean Sinclair, a fourth-year Ph.D. student in the School of Operations Research and Information Engineering, sees the entire world as a mix of probability and optimization problems. “Something I enjoyed as an undergrad and still enjoy doing today is working a lot with probability and statistics and using them to optimize the way that we run algorithms in the real world to address actual problems,” he said.

This love of math was not always evident, though. “To be honest, when I was kid, I was awful in school,” Sinclair said. “It wasn’t until high school, when I started working with this one teacher, Deb Post, that I really started to find my stride.” For much of his high school career, Sinclair did not attend traditional math classes. Instead, he worked with Post, staffing a math help desk and engaging in independent study. In this way, he discovered his love of teaching alongside his fascination with probability and statistics.

Sinclair is working with ORIE Professors Christina Lee Yu and Sid Banerjee on ways to use math to optimize the operations of the Food Bank of the Southern Tier. The FBST works to meet the weekly food needs of more than 20,000 people in a six-county area of upstate New York that spans nearly 4,000 square miles.

Sinclair explained that the COVID-19 pandemic has forced changes to the way the food bank gets food to people. “Trucks from the food bank have to travel to different locations throughout the day, and at each location they have to decide how much food to distribute, not knowing how much food will be needed at subsequent stops,” he said. Sinclair uses a framework for sequential decision-making that can optimize the organization’s operations even under conditions of uncertainty.

This work is certainly in keeping with advice Sinclair received from his undergraduate advisor at Montreal’s McGill University, where he majored in

MATH WITH A PURPOSE— USING PROBABILITY AND STATISTICS FOR THE GREATER GOOD

mathematics. Shortly after graduating from McGill, Sinclair joined the U.S. Peace Corps and taught math in Ghana for three years. Upon his return to the U.S., he met with his former advisor who told him that studying operations research would give Sinclair a way to do “math with a purpose.”

Sinclair has realized the truth of this at Cornell. “I look around the department and see how relevant so much of the work is,” he said. “COVID testing policies, classroom assignments, final exam schedules, ambulance deployment — these are all challenges people in ORIE are tackling.”

This year, Sinclair plans to broaden his focus to include the creation of a simulator for the broad category of problems represented by the food bank’s challenge. “There are these stereotypical operations research-type problems that involve sequential decision-making,” he said. “And we want people that study reinforcement learning to be able to test their algorithms on these types of problems, too. Right now, there’s no good way for them to do that.”

Sinclair’s work on this project is especially gratifying because it allows him to combine the research he loves with teaching and mentoring undergraduates. “I love working with people through the struggle of trying to understand how something



Sean Sinclair

works,” he said. “I remember that struggle very clearly from when I was a kid, and it feels good now to help students make sense of things.” He is hoping to eventually find a position that allows him to keep this balance.

“Once I graduate I want to find a faculty position at a university that allows for a satisfying balance between teaching and research,” Sinclair said. “I don’t see myself running a high-powered super-serious research lab, but I also don’t imagine devoting all of my time to teaching. I truly enjoy both and want to find a department that matches my priorities.”

When Sinclair is not thinking about probability, statistics, and optimization, he can be found on his bicycle or on Cornell’s Lindseth Climbing Wall — two activities that allow him the chance to focus intently on the immediate challenge and offer a break from the stressors of academia.

By Chris Dawson

NEWS FROM INFORMS MEETING

Brenda Dietrich Ph.D. '86, the Arthur and Helen Geoffrion Professor of Practice in Cornell's School of Operations Research and Information Engineering, was awarded the INFORMS President's Award during the INFORMS Annual Meeting held October 24-27 in Anaheim, Calif.

"INFORMS is proud to recognize Dr. Dietrich with its 2021 President's Award, in recognition of her outstanding contributions in research and leadership at IBM, and for her service to INFORMS and the operations research and analytics community at large," said INFORMS President Stephen Graves.

Throughout her career, Professor Dietrich has provided extraordinary service to INFORMS serving on the INFORMS Board as vice president for Practice, and as president of INFORMS. She was a founding member of the Forum for Women in Operations Research and Management Science (WORMS) and chaired the advisory committee for the first two INFORMS Practice Conferences (now the INFORMS Business Analytics Conference).

"INFORMS is proud to recognize Dr. Dietrich with its 2021 President's Award, in recognition of her outstanding contributions in research and leadership at IBM, and for her service to INFORMS and the operations research and analytics community at large."

— Stephen Graves, INFORMS President

BRENDA DIETRICH RECEIVES INFORMS PRESIDENT'S AWARD

"I am truly appreciative of this award, and of all that INFORMS does," said Dietrich. "I hope to continue my association with INFORMS and the profession of operations research for many more years."

Professor Dietrich is an INFORMS Fellow and an elected member of the National Academy of Engineering. She has been awarded the INFORMS Kimball Medal for her service contributions, INFORMS Impact Prize for being a founding member of COIN-OR, and the Award for the Advancement of Women in OR/MS.



Professor of Practice Brenda Dietrich

Professor Dietrich earned her Ph.D. in operations research from Cornell and joined IBM Research in 1984. At IBM, she developed and deployed O.R. models and algorithms, both throughout IBM businesses and for IBM clients, with great impact. Her research has resulted in over

three dozen patents or pending patents, and a similar number of journal publications. These efforts contributed to IBM being awarded an Edelman Award, several Wagner Prizes, and the INFORMS Prize.

Starting in 2001, Professor Dietrich led the Mathematical Sciences function in the IBM Research division for over a decade. She was named an IBM Fellow in 2007, the company's pre-eminent technical distinction, granted in recognition of outstanding and sustained technical achievements and leadership. In 2008 she was appointed IBM vice president and subsequently became the chief technology officer and strategist for IBM's Business Analytics group. In these positions, she led IBM's efforts to create and deploy business analytics methods within IBM, within its software products, and through its services engagements.

After 33 years at IBM, she returned to Cornell in 2017 to work with students, in teaching and research.

NEWS FROM INFORMS MEETING

The Institute for Operations Research and the Management Sciences (INFORMS), the largest association for decision and data sciences, has announced that Mark Lewis, the director of the School of Operations Research and Information Engineering at Cornell, is among the 12 outstanding members named as 2021 Fellows, one of the highest honors in the O.R. profession.

“When I scroll through the list of fellows, I find several people that I admire and some that have served as informal mentors along my journey,” said Lewis. “This makes it all the more gratifying to be recognized as a member of this prestigious group.”

The 2021 INFORMS Fellows were inducted during the 2021 INFORMS Annual

MARK LEWIS NAMED AN INFORMS FELLOW

Meeting, Oct. 24-27, held both virtually and on location in Anaheim, Calif. INFORMS Fellows are honored for their outstanding lifetime accomplishments and contributions in operations research and analytics.

Lewis is the Maxwell M. Upson Professor of Engineering in ORIE. He is being honored for his great impact in advancing minority issues, extended professional service to INFORMS, excellence in academic leadership, and research and teaching in stochastic modeling.



Professor Mark Lewis

Mark Lewis among inaugural INFORMS MIF Fellows

Mark Lewis, the Maxwell M. Upson Professor of Engineering and director of the School of Operations Research and Information Engineering at Cornell University, is among the inaugural class of INFORMS Minority Issues Forum (MIF) Fellows.

Celebrating its 20th anniversary, the MIF board chose to celebrate its forum by awarding a MIF Fellow recognition to five members who have significantly helped the forum grow within INFORMS, and for the service they have rendered towards MIF's mission.

“My role at the beginning of the forum was really in setting up all of the infrastructure,” Lewis said. John Birge (University of Chicago Booth School of Business) had the idea that we should have a forum and approached me on getting one started. The main thing up front was in showing INFORMS that there was support for a forum focused on minority issues.”

Lewis wrote the first draft of MIF's bylaws from a draft provided by the Women in OR/MS leadership but noted it wasn't just a one-person job.

MINORITY ISSUES FORUM

“There were several people that had a hand in editing and agreeing to the bylaws so that they fit the topic. That collaboration was crucial,” said Lewis, who has twice served as MIF president.

Lewis, who was also named an INFORMS Fellow earlier this year, joins William Christian, Jr. (U.S. Department of Defense/Paygevity, Inc.), Illya Hicks (Rice University), Julie Ivy (North Carolina State University) and Maria Mayorga (North Carolina State University).

The purposes of the INFORMS Minority Issues Forum are to foster minority representation in operations research/management science, to develop ties between those interested in increasing the number of minority participants in OR/MS and to disseminate information about the issues facing minority researchers and practitioners.

NEWS FROM INFORMS MEETING

Andrea Lodi, the Andrew H. and Ann R. Tisch Professor at Jacobs Technion—Cornell Institute at Cornell Tech and a member of the School of Operations

Research and Information Engineering graduate field faculty, has been selected as the winner of the 2021 INFORMS Optimization Society Farkas Prize.

Professor Lodi received his Ph.D. in 2000 from the University of Bologna and he has received the 2004 Herman Goldstine Fellowship in Mathematical Sciences by IBM T.J. Watson. Prior to joining Cornell Tech in 2021, he was Canada Excellence Research Chair at Polytechnique Montreal (2015-2021) and Professor of Operations Research at the University of Bologna (2007-2015).

“I am deeply honored of receiving the 2021 INFORMS Optimization Society Farkas Prize and being in such a good company of the distinguished past winners,” said Lodi. “I am very happy to share this prize with all my collaborators over a journey of more than 20 years and the institutions in which I have spent the first part of my scientific career, namely University of Bologna, IBM and Polytechnique Montreal. This journey led me now to Cornell Tech and the Farkas Prize boosts my enthusiasm for the next 20+ years to come!”

The Farkas Prize of the INFORMS Optimization Society was established in 2006 and is awarded annually at the INFORMS Annual Meeting to a mid-career researcher for outstanding contributions to the field of optimization, over the course of their career. Such contributions could include papers (published or

ANDREA LODI NAMED WINNER OF PRESTIGIOUS FARKAS PRIZE



Professor Andrea Lodi

submitted and accepted), books, monographs and software. The awardee will be within 25 years of their terminal degree as of January 1 of the year of the award. The prize serves as an esteemed recognition of colleagues in the middle of their career.

In addition to receiving a cash prize and citation certificate, Professor Lodi was invited to give a 25-minute presentation at the INFORMS Annual Meeting. Award winners are also asked to contribute an article about their award-winning work to the Optimization Society newsletter.

INFORMS Annual Meeting

Oct. 24-27, 2021 • Anaheim, Calif.

- Brenda Dietrich received the INFORMS President’s Award, which recognizes, and thereby encourages, “important contributions to the welfare of society by members of our profession at the local, national, or global level.”
- Mark Lewis was elected a 2021 INFORMS Fellow, “For great impact in advancing minority issues, extended professional service to INFORMS, excellence in academic leadership, and research and teaching in stochastic modeling.”
- Mark Lewis was selected as a member of the inaugural class of the Minority Issues Forum (MIF) Fellows, recognizing members “who have significantly helped the forum grow within INFORMS, and for the service they have rendered towards MIF’s mission.”
- Andrea Lodi won the Optimization Society Farkas Prize
- Somya Singhvi ’15 won the Dantzig Ph.D. Dissertation Prize.
- Sid Banerjee, Alberto Vera Ph.D. ’21, Daniel Freund Ph.D. ’18, and Itai Gurvich won the best paper publication award from the Applied Probability Society.
- Ph.D. student Xiangyu Zhang (who is advised by Peter Frazier) won the Applied Probability Society’s best student paper prize for his paper “Restless bandits with many arms: Beating the central limit theorem”. Mark Gluzman (Jim Dai’s student from CAM) was also a finalist.
- Ariah Klages Mundt (advised by Andreea Minca) was named a finalist for the INFORMS Finance Section Best Student Paper for their paper, “While Stability Lasts: A Stochastic Model of Stablecoins.”
- Devin Smedira ’21 (advised by David Shmoys) was named a finalist in the INFORMS Undergraduate Research Prize for their joint paper, “Scheduling Appointments Online: The Power of Deferred Decision-Making.”

ORIE FACULTY NEWS

The Cornell Board of Trustees has elected Peter Frazier, Associate Professor with indefinite tenure in the School of Operations Research and Information Engineering, the inaugural Eleanor and Howard Morgan Professor.

Frazier joins Mark Lewis, David Shmoys, Jim Dai, Shane Henderson, Adrian Lewis, James Renegar, David Ruppert, and Brenda Dietrich as chaired professors in ORIE. Being named a chaired professor is the highest academic honor Cornell bestows.

Frazier's chaired professorship is named for Eleanor and Howard Morgan Ph.D. '68. Howard Morgan is the chairman of B Capital Group, a venture capital firm specializing in startups and growth-stage investments in a number of industries. He arrived at Cornell in 1965 as a doctoral student in operations research but found himself equally interested in the new Department of Computer Science that had formed that year. He minored in computer science and quickly began to see the potential for applying that knowledge to operations research and other disciplines.

"Eleanor and I are delighted to have Peter Frazier appointed as the Inaugural Eleanor and Howard Morgan Professor of ORIE," Howard Morgan said. "His important work on the decision processes around Covid, including the testing plans, and the benefits of going in person in the fall have been properly acknowledged as crucial to Cornell's successful navigation through this pandemic. We are sure he'll have a lot of impact in other areas in the coming years."

After obtaining his Ph.D., Morgan joined the faculty in both Cornell's Department of Operations Research and the Department of Computer Science and then eventually found himself teaching at the University of Pennsylvania. It was during his time as a professor he began researching personal uses for computers. His work with user interfaces and computer networks led to his early involvement in ARPAnet, the precursor for the internet. Before retiring from First Round Capital in 2017, the firm he co-founded, he was one of the first investors in the ride-sharing service, Uber, Blue Apron, the popular meal-kit-delivery service, and Roblox, the ultimate virtual universe that allows its users to create and share experiences with friends.

PETER FRAZIER ELECTED INAUGURAL ELEANOR AND HOWARD MORGAN PROFESSOR



Associate Professor Peter Frazier

ORIE Named Professorships

Jim Dai	Leon C. Welch Professor in Engineering
Brenda Dietrich	Arthur and Helen Geoffrion Professor of Practice.
Peter Frazier	Eleanor and Howard Morgan Professor
Shane Henderson	Charles W. Lake, Jr. Professor in Productivity
Adrian Lewis	Samuel B. Eckert Professor of Engineering
Mark Lewis	Maxwell M. Upson Professor of Engineering
Jim Renegar	Class of 1912 Professor of Engineering
David Ruppert	Andrew Schultz Jr. Professor of Engineering
David Shmoys	Laibe/Acheson Professor of Business Management and Leadership Studies

The Cornell University Board of Trustees has elected Mark E. Lewis, director and professor in the School of Operations Research and Information Engineering, the Maxwell M. Upson Professor of Engineering effective July 1, 2021, succeeding Paul Steen who passed away in September 2020.

“It is both privilege and an honor to hold this chair,” Lewis said. “Everything I have learned about the Upson family is that they embody what Cornell Engineering is about; dedicated to discovery and service. I hope to live up to the high standard of this distinction.”

The Maxwell M. Upson Professorship in Engineering was established in 1966, through the bequest to the University from the late Mary Shepard B. Upson. In her will, Mrs. Upson, the wife of the Cornell Trustee Emeritus, directed that the majority of her estate be used to further the goals of Cornell’s College of Engineering.

After graduating from the University

MARK LEWIS ELECTED THE MAXWELL M. UPSON PROFESSOR OF ENGINEERING

of North Dakota in 1896, Upson enrolled at Cornell and received a mechanical engineering degree in 1899. He was a mechanic with Westinghouse, Church, Kerr & Co. after his campus years and soon became a managing engineer. In 1907 with money he received from George Westinghouse for rights to an automatic gas producer he had invented, Upson bought a controlling interest in the Raymond Concrete Pile Company. In 1958, the company’s corporate name was changed to Raymond International to emphasize the growing importance of its overseas operations. Upson served on Cornell’s Board of Trustees from 1925-1960.



Professor Mark Lewis

At its spring 2021 meetings, the Cornell University Board of Trustees elected three members of the School of Operations Research and Information Engineering

faculty to appointment with indefinite tenure, effective July 1.

Siddhartha Banerjee, Jamol Pender and Yudong Chen were all elected associate professor with indefinite tenure.

Banerjee joined the faculty at Cornell in July 2015 as an assistant professor. He received his Ph.D. in 2013 from the Department of Electrical and Computer Engineering at the University of Texas at Austin and was a postdoctoral researcher in the Social Algorithms Lab at Stanford from 2013-15. Sid’s research focuses on stochastic modeling and the design of algorithms and incentives for large-scale systems.

Pender joined the faculty at Cornell in July 2015 as an assistant professor in ORIE. He received his Ph.D. from the Department of Operations Research and Financial Engineering at Princeton University in 2013.

BANERJEE, PENDER, CHEN PROMOTED TO ASSOCIATE PROFESSOR RANK

His research interests include queueing theory, applied probability, Markov processes, control theory, and mathematical finance.

Chen, who is on leave from Cornell, joined the ORIE faculty in August 2015. He obtained his Ph.D. in electrical and computer engineering in 2013 from the University of Texas at Austin.



Associate Professors Sid Banerjee, Jamol Pender and Yudong Chen

Christina Lee Yu, an assistant professor in Cornell's School of Operations Research and Information Engineering, has received the Intel® Rising Star Faculty Award (RSA).

Professor Yu is one of 10 "promising early-career academic researchers who lead some of the most important technology research of our time," Intel said in a statement. "The chosen faculty members work with disruptive technologies that have the potential to advance the future of computing in fields encompassing computer science, electrical engineering, computer engineering, material science, and chemical engineering."

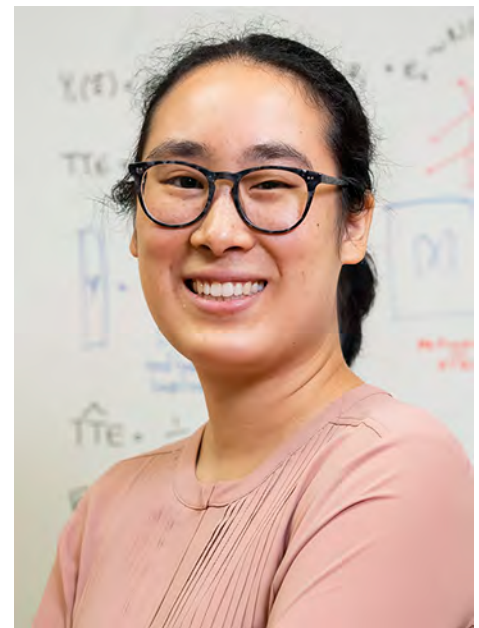
"I am honored to receive the Intel® Rising Stars award and am grateful for Intel's commitment to support early career researchers," Yu said. "I look forward to collaborating with them to further the impact of my research."

Professor Yu's research is at the interface of modern statistics and machine-learning algorithms for high-dimensional data analysis and sequential decision making. Her accomplishments include designing scalable algorithms with optimal theoretical guarantees for statistical inference with noisy high dimensional data; provably reducing memory and data requirements of reinforcement learning algorithms by using adaptive discretization to exploit structure; and proposing simple policies for sequential multi-objective fair resource allocation. Her research bridges theory and practice in a way that has led to fundamental developments in theoretical understanding of commonly used algorithms as well as novel design of practical machine-learning algorithms to aid better

CHRISTINA LEE YU RECEIVES INTEL® RISING STAR FACULTY AWARD

decision making.

The RSA program recognizes community members who are doing exceptional work in the field and facilitates long-term collaborative relationships with senior technical leaders at Intel. Recipients of this award are also distinguished for exemplifying innovative teaching methods and increasing the participation of women and underrepresented minorities in computer science and engineering.



Assistant Professor Christina Lee Yu

Reinforcement learning proposal earns duo JPMorgan Research Award

Assistant Professor Christina Lee Yu and Qiaomin Xie, an assistant professor at the University of Wisconsin-Madison, are the recipients of a 2021 JPMorgan Faculty Research Award.

"Reinforcement learning has emerged as a promising approach for solving challenging sequential decision-making problems in which the model may be unknown a priori," said Yu. "The focus has largely been on designing general purpose algorithms that are powerful in their ability to handle a wide variety of

models, and yet do not efficiently exploit existing problem structure."

Yu and Xie propose designing reinforcement learning algorithms that efficiently exploit latent low rank structure in the problem, a common property that may arise in many applications, including two-sided financial markets or queueing models for call centers. This research will have an impact on both methodological development and practical applications.

"This work will enable efficient learning of optimal policies with lower computing and data requirements in high

dimensional domains of both economic systems and cognitive workflows," Yu said. "The proposed algorithms will find near-optimal control policies for complex, high-dimensional queueing problems, for which finding analytical solutions is notoriously difficult, if not impossible, despite decades of research."

JPMorgan Research Awards aim to advance AI research to solve real-world problems. JPMorgan's annual awards support AI research and are a part of its \$10 billion-plus annual investment in technology and innovation.

Mark E. Lewis, director of the School of Operations Research and Information Engineering in the College of Engineering, and Jamila Michener, associate professor in the Department of Government in the College of Arts and Sciences, are the recipients of this year's Faculty Award for Excellence in Research, Teaching and Service through Diversity.

The awards were announced by President Martha E. Pollack and Provost Michael I. Kotlikoff based on nominations from students, faculty and staff, and the recommendations of a selection committee. The recognition comes with a \$15,000 prize.

"We're so pleased to honor Professors Lewis and Michener for the wide-ranging and sustained roles they have played in building a community of belonging at Cornell," Pollack said. "They are dedicated advocates for equity and inclusion in their scholarship, pedagogy, mentorship and service, and their impact has extended across the university and beyond."

The award, launched in 2019, was created to recognize distinctive and outstanding accomplishments that lead to systemic and transformational change in research or creative work, teaching and mentoring, and service and outreach. Students, staff, and faculty are invited to nominate tenure track and tenured faculty.

Students praised Lewis and Michener for taking an interest in them beyond their academic pursuits. Lewis, who is also the Maxwell M. Upson Professor of Engineering in the College of Engineering, once asked a student how her job application was proceeding. Discovering she was discouraged for failing an automated exam, Lewis reached out to the employer who ultimately hired her.

An accomplished researcher, Lewis said, "Seeing my doctoral students grow, graduate and flourish" is more gratifying

LEWIS, MICHENER HONORED FOR DIVERSITY CONTRIBUTIONS

than counting citations.

Lewis' leadership roles at Cornell have included associate dean and senior associate dean for diversity and faculty development in the College of Engineering. During his tenure, the college reached gender parity in overall undergraduate enrollment and first-year classes.

As associate dean he pushed faculty search committees to diversify interview and applicant pools. Search committees sought out highly talented women for interviews, resulting in an increase from 16.7% in 2014 to 22.5% in 2019 in the number of tenure track women faculty in the college. Aside from overseeing new faculty hiring and the promotion of junior faculty, he tackled the challenge of finding employment opportunities for the partners of new and existing faculty.

"Mark served as the college's conscience on all matters related to equity and inclusion," said Lance Collins, who served as the Joseph Silbert Dean of Engineering at Cornell from 2010 to 2020.

Lewis also chaired the Provost's Task Force to Enhance Faculty Diversity in 2017-18. Based on the group's recommendations, the university now provides colleges with additional funding to bridge the hiring of faculty who contribute to the diversity of



Professor Mark Lewis

Associate Professor Jamila Michener

their unit; requires applicants for tenure-track faculty and senior leadership positions to submit statements outlining how they will advance diversity at Cornell; and offers a postdoctoral fellowship program supporting those with exceptional promise with additional time and mentoring prior to starting the tenure track at Cornell, among other changes.

Lewis's leadership was instrumental in securing funding for the Cornell Sloan and Cornell Colman fellowship programs for underrepresented doctoral students. Cornell is one of eight institutions nationwide and the only one in the Ivy League to offer these fellowships.

Lewis also co-created the Ephraim Garcia Engineering Society, providing community for underrepresented minority faculty and opportunities to meet with leadership in the College of Engineering. He supervised the Diversity Programs in Engineering, giving tutoring and academic support for first-generation and underrepresented minority students.

By Lori Sonken

ORIE FACULTY NEWS

Henderson receives Cornell Tech Faculty Teaching Award

Shane Henderson, the Charles W. Lake, Jr. Professor in Productivity in Cornell's School of Operations Research and Information Engineering, received the Cornell Tech Faculty Teaching Award for the 2020-21 academic year.

Voted on by the students, the award is presented annually at the Cornell Tech Recognition Ceremony.

Professor Henderson's overall professional goal is to contribute to both research and learning in the theory and application of stochastic simulation and applied probability, with emphasis on the interface between these areas and optimization. He is greatly interested in and motivated by applications with strong societal relevance, including bike sharing, medical scheduling, and ambulance planning.

Professor Henderson teaches courses in probability and statistics, simulation, and mathematical modeling. He is a great believer in case-based learning and uses a problem-driven classroom approach in his mathematical-modeling courses. He strives for both mathematical rigor and practical relevance in the classroom. This year he taught the course "Optimization Methods" in the fall and "e-Logistics" in the spring, and his experiences in ambulance modeling, ride hailing, bike sharing, and medical scheduling were invaluable in developing the content of the courses and bringing them to life.



Professor Shane Henderson

Manxi Wu joins ORIE as visiting assistant professor

Manxi Wu has joined the ORIE faculty as a visiting assistant professor and will join the ORIE faculty in July 2022.

In addition to her visiting professor appointment at Cornell, Professor Wu is also a postdoctoral researcher with the Department of Electrical Engineering and Computer Sciences at the University of California, Berkeley, working with Professor Shankar Sastry. She will be a research fellow in the Learning and Games Program at the Simons Institute for the Theory of Computing at UC Berkeley in the spring of 2022.

Her research studies the role of platforms for information provision and autonomous services in the operations of modern

transportation networks. She develops new models that capture the interactions between platforms and strategic users under the physical constraints and uncertainty in transportation networks. Professor Wu also designs information and incentive guidelines for platforms to induce socially desirable outcomes such as system efficiency and resiliency. Her work builds on foundations in game theory, incentive design, and network optimization.

Professor Wu completed her Ph.D. in summer 2021 from the Institute for Data, Systems, and Society at the Massachusetts Institute of Technology supervised by Professor Saurabh Amin. She holds an M.S. in transportation from MIT, and a B.S. in applied mathematics from Peking University.



Assistant Professor Manxi Wu

ORIE's Garg receives honorable mention for SIGecom Doctoral Dissertation Award

Assistant Professor Nikhil Garg has received honorable mention for his dissertation, "Designing Marketplaces and Civic Engagement Platforms," by the Association for Computing Machinery (ACM) Special Interest Group for Economics and Computation (SIGecom) Doctoral Dissertation Award competition.

The SIGecom recognizes an outstanding dissertation in the field of economics and computation. The award is conferred annually at the ACM Conference on Economics and Computation.

"Nikhil's thesis offers wide-ranging methodological contributions to platform design with applications to surge pricing, rating systems, and preference elicitation for participatory budgeting," the committee wrote. "Nikhil's work combines elegant theoretical modelling with impressive experimental and empirical analysis. His deep engagement with real-world platforms makes his



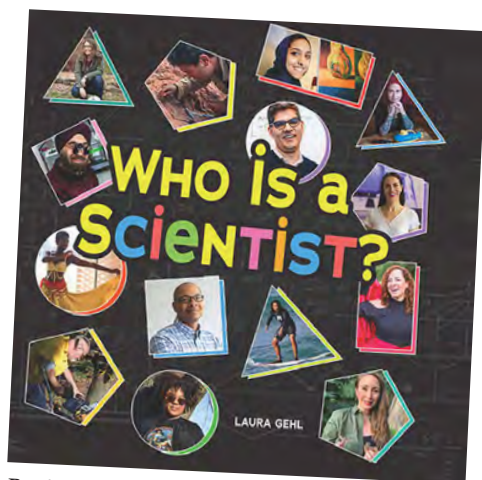
Assistant Professor Nikhil Garg

work a wonderful example of applied research on the intersection of operations research, economics and computer science."

Garg, a member of ORIE's Cornell Tech faculty, received his Ph.D. from Stanford University in 2020, where he was part of the Society and Algorithms Lab and Stanford Crowdsourced Democracy Team and advised by Ramesh Johari and Ashish Goel. He also received B.S. and B.A. degrees from the University of Texas at Austin in 2015.

Mark Lewis featured in new book, Who is a Scientist?

When Mark Lewis received an email from children's book author Laura Gehl, asking him to participate in her latest project, he didn't need much convincing. Now the Maxwell M. Upson Professor of Engineering and ORIE director is among 14 scientists featured to a target



Professor Mark Lewis is featured in a new book, "Who is a Scientist?"

audience of three to 10-year-olds in Who Is a Scientist?, released October 5.

In the latest of Gehl's nearly two dozen popular children's books, colorful photographs show the diverse group of scientists — from Mark (all participants are identified by their first names) in operations research to Jagmeet in neuroscience, Isha in meteorology, and Joyce in entomology — at work and play. Readers learn that Lewis, for example, "studies how math can be used to make people's lives better" and that "he also enjoys playing basketball and watching movies." A separate paragraph aimed at older kids adds details about the field of OR and his research.

"I wanted kids to see that scientists can study all types of different things and that scientists and kids share a lot of the same passions — for dance and basketball and eating junk food and playing with their pets," says Gehl, herself a neuroscientist and a mother of four. "It makes it easier for the kids to imagine that they can be scientists, too." She was eager to include Lewis, she explains,

"because I think mathematicians are often neglected when people talk about cool scientific careers."

Aware of studies finding that most kids think of scientists as white men, Gehl was just as careful to offer as many children as possible a chance to recognize themselves in the individuals shown. The group includes Black, White, Asian American, Latinx, and Indigenous scientists; a scientist with full-sleeve tattoos; a scientist wearing lipstick; a scientist who uses forearm crutches; and a scientist who wears a headscarf. "There should be no 'mold' for a scientist; our diversity is our strength," Lewis agrees.

While Lewis had his father — an engineer — and other family members and their friends to look to as role models, he is well aware of the lack of diverse representation in scientific careers. From kindergarten through his Ph.D., he had only one Black teacher, a math professor in college who introduced him to OR. "Outside of my study of queues, I spend a lot of time and energy thinking of how to change this and to help provide opportunities for students and faculty from underrepresented groups," says Lewis. "Knowing the goal of Laura's project is in line with what I am passionate about made it all the more gratifying to take part." Plus, he adds, "it was a lot of fun."

Book trailer: <https://bit.ly/3l8tjB0>

By Olivia M. Hall

The image shows a photograph of Professor Mark Lewis, a Black man with glasses, wearing a blue and white plaid shirt. He is standing with his arms crossed next to a whiteboard. The whiteboard has some mathematical equations written on it, including $EQN's$, $(x,y) + w \sum_{j=1}^n x_j y_j$, and $DISCOUNTED COST OPTIMIZATION EQN$. Overlaid on the right side of the photo is a text box with a white background and a red border. The text in the box reads: "He studies how math can be used to make people's lives better. He also enjoys playing basketball and watching movies." Below the photo, there is another text box with a white background and a red border. The text in this box reads: "Mark Lewis is a professor who focuses on operations research. Operations research uses math to help businesses make good decisions. Mark helps figure out how cars and trucks can get from place to place faster or how much items should cost when bought on the internet. Mark also studies waiting in lines and how to make the wait time shorter." In the bottom right corner of the text box, there is a small red circle with the number "13" inside.

SCHALEKAMP, SHMOYS RECEIVE COLLEGE OF ENGINEERING TEACHING AWARDS

Two members of the ORIE faculty received teaching excellence awards for 2020-21 from Cornell's College of Engineering.

Senior Lecturer Frans Schalekamp was named the winner of the Sonny Yau '72 Excellence in Teaching Award, while David Shmoys, the Laibe/Acheson Professor of Business Management and Leadership Studies, has received the Douglas Whitney '61 Excellence in Teaching Award.

"Dr. Schalekamp is an energetic, passionate teacher who can teach virtually any course in ORIE adeptly," said Mark Lewis, the Maxwell M. Upson Professor of Engineering and ORIE Director. "To give you a sense of his consistency and versatility, during the spring semester of 2021, amidst the ongoing pandemic, Professor Schalekamp took on teaching over 300 students in two of our largest courses."

"Amazing class, amazing (perhaps the best?) professor, incredible environment and the most wonderful way to start my Tuesday and Thursday mornings," said one ORIE 3310 student.

A student in his ORIE 4350 class wrote, "Professor Schalekamp is one of the most empathetic, knowledgeable, and highly-skilled professors that I've had at Cornell. Having taken three classes from him, I enjoy his teaching style and find he takes genuine care in ensuring his students are learning and doing well outside of the classroom."

Lewis noted that Shmoys' contributions are "both conventional (he is an excellent teacher) and unconventional (he has had an outsized impact on the education of our students). I find it hard to believe that there could be any greater contribution to teaching than dedicating a significant portion of your time to the redevelopment of the university-wide course roster complete with times and classrooms," Lewis said. "This is exactly what Professor Shmoys did. His effort required a review of every classroom, every seat and every time slot (sometimes including evening and weekends) to ensure student and professor safety. Without his efforts, the university may not have been able to reopen in fall 2020."

"Professor Shmoys is a very engaging lecturer," wrote one ENGRI 1101 student. "This is by far my favorite class I have taken at Cornell and confirmed my goal to major in ORIE."



Frans Schalekamp received the 2020-21 Sonny Yau '72 Excellence in Teaching Award.



David Shmoys was named the Douglas Whitney '61 Excellence in Teaching Award winner for 2020-21.

Schalekamp, who received his Ph.D. in operations research from Cornell in 2007, was named the ORIE Professor of the Year in a vote of undergraduate students for 2020-21. He has worked both in academia and in industry on three continents, and on areas ranging from plant breeding and genetics to logistics. Former academic positions were at the Institute for Theoretical Computer Science at Tsinghua University in Beijing, China, the Department of Mathematics at the College of William & Mary in Williamsburg, Va., and the Department of Computer Science at Cornell.

Professor Shmoys, who has won the Sonny Yau '72 award four times (1995, 1998, 2005 and 2012), is the Laibe/Acheson Professor and Director of the Center for Data Science for Enterprise & Society at Cornell. He obtained his Ph.D. in computer science from the University of California at Berkeley in 1984, and held postdoctoral positions at MSRI in Berkeley and Harvard University, and a faculty position at MIT before joining the faculty at Cornell University. He was Chair of the Cornell Provost's "Radical Collaborations" Task Force on Data Science and was co-Chair of the Academic Planning Committee for Cornell Tech.

New research from the College of Engineering lays out in detail why ranked-choice voting, combined with multi-member legislative districts, promotes fair representation, particularly when it comes to blunting gerrymandering — the party in power’s ability to map a district to its political advantage.

The work comes as the results of the 2020 U.S. Census, released Aug. 12, will be used to reapportion legislative districts across the nation, including in New York, one of a handful of states that lost a seat in the House of Representatives due to population drop.

“It’s not a coincidence that we’re particularly focused on this, given the completion of the census,” said David Shmoys, the Laibe/Acheson Professor of Business Management and Leadership Studies in the School of Operations Research and Information Engineering. “Now is the time that there’s the most attention paid to what’s going right and what’s going wrong. For the handful of states that have independent [election] commissions, if we can get their ear and move forward,

“Now is the time that there’s the most attention paid to what’s going right and what’s going wrong. For the handful of states that have independent [election] commissions, if we can get their ear and move forward, that would also be fantastic because we do think we have tools that would be of value.”

— David Shmoys

RANKED CHOICE, MULTIMEMBER DISTRICTS BLUNT GERRYMANDERING

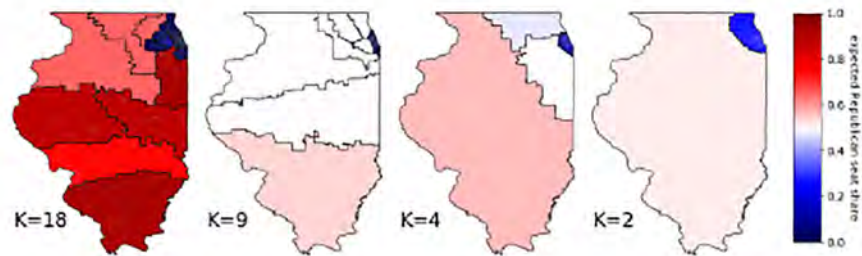


Figure 13: Example fair multi-member plans for Illinois.

that would also be fantastic because we do think we have tools that would be of value.”

Shmoys is co-author of “Combatting Gerrymandering with Social Choice: The Design of Multi-Member Districts,” published on arXiv this month. Co-author Nikhil Garg, assistant professor at ORIE and at the Jacobs Technion — Cornell Institute at Cornell Tech, presented the research at the annual meeting of the Institute for Operations Research and the Management Sciences in October in Anaheim, Calif.

Other co-authors include Wes Gurnee ’20, an operations research doctoral student at the Massachusetts Institute of Technology, and David Rothschild, an economist at Microsoft Research.

The researchers found that, in terms of both fairness and preserving how geographically close residents are to their representatives, the best option is three-member legislative districts in which voters rank their choices and the candidate with the most first-place votes is the winner; surplus votes are transferred to voters’ next preferences.

This work is an extension of the 2020 “fairmandering” research led by Gurnee, in which he developed a new mathematical method to try to inject fairness into the fraught process of political redistricting. The researchers devised a way to efficiently incorporate ranked-choice voting — which Garg studied in his doctoral dissertation — into the method. Among other things, the research showed that it takes more than good intentions to create

a fair, representative (politically and geographically) district.

Ranked-choice voting, just used in the New York City mayoral primaries, reallocates votes from non-viable to viable candidates. In a multi-member district, it also reduces the impact of each voter after a candidate they support has been declared a winner.

The new study sheds light on potential outcomes of the Fair Representation Act, first introduced in the U.S. House of Representatives in 2017 and reintroduced twice since. The Democrat-sponsored legislation would establish, among other things, ranked-choice voting in all House races and multi-member congressional districts.

“Our goal is to put a tool in the hands of policymakers and say, ‘Here is a large collection of hypothetical district maps and voting rules; these are the inherent tradeoffs in different dimensions of representation forced by geography and the election rules,’” Gurnee said. “They can use this information as the basis for a regionally aware policy solution.”

The most common current method for electing representatives at all levels of government is the winner-take-all, single-member district: For example, New York state has 27 congressional districts, each represented by a single House member.

“Our work shows that many of the challenges with redistricting — from ‘natural’ geographic imbalances to partisan gerrymandering — stem from the winner-takes-all nature of our districts, and that even small multi-member districts would address them,” Garg said, noting that in certain instances it’s nearly impossible to come up with proportionate, politically balanced



Professor David Shmoys

maps with single-member districts.

In Massachusetts, for example, the state is not only strongly Democratic but “it’s relatively, consistently, overwhelmingly Democratic throughout the whole state,” Shmoys said. New York, on the other hand, is seen as a blue state but has Republican strongholds both upstate and downstate.

Multimember districts are rare but not unheard of. In 1962 a total of 41 state legislatures had them; today, 10 states still elect representatives for at least one state governmental chamber in such a manner. Arizona, for example, is divided into 30 legislative districts, with each electing one senator and two representatives.

The authors noted that winner-take-all voting in multimember districts — like those currently in place in Arizona and other states with multimember districts — enable the most egregious gerrymandering in nearly all district sizes “and should be avoided,” they wrote.

The bottom line: A multimember district, with some form of ranked-choice voting, severely limits the gerrymanderers’ ability to draw themselves into the Election Day winner’s circle.

“Once you go to the right social-choice function, and in compact, three-member districts, the ability to create a partisan advantage is far more limited,” Shmoys said. “We’re handicapping the gerrymanderers.”

By Tom Fleischman

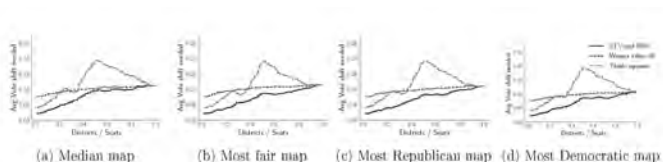


Figure 4: The average vote shift needed in each map (averaged across districts in a map and across states) to shift the number of seats won by each party by at least one. The larger the vote shift needed in a district, the less *competitive* is the district. The four plots show the various maps selected. For example, (a) shows the vote shift needed when the median (in terms of party seat share) map is selected for each setting.

Discrete optimization techniques have been successfully applied to many industrial applications such as production planning, scheduling and logistics. However, these techniques—especially integer linear programming (IP)—are not yet widely used in AI applications even for those that are combinatorial in nature (e.g., classification or clustering). An important reason behind this is the presence of large data sets in AI applications, which usually lead to large-scale IPs that are hard to solve.

ORIE Professor of Practice Oktay Gunluk has received a grant of more than \$450,000 from the U.S. Department of Defense/Office of Naval Research to study integer programming models for interpretable binary classification.

“With the use of machine learning (ML) techniques to automate socially and legally sensitive decision-making tasks such as lending, hiring, and college admissions, the need for interpretable ML models is

DOD AWARDS GUNLUK GRANT TO STUDY INTERPRETABLE BINARY CLASSIFICATION

increasing” Gunluk said. “Moreover, in most of these applications, the classification algorithms are required to be fair to all those affected.”

As one would expect, there is usually a trade-off between interpretability/fairness and predictive accuracy. This trade-off can be modelled using an IP formulation, which has an exponential size. Gunluk and Ph.D. student Connor Lawless would study computational techniques to solve these large-scale formulations and investigate related theoretical problems. They would also collaborate with researchers from the IBM T. J. Watson Research Center and Wisconsin University.



Professor of Practice Oktay Gunluk

Models developed by university experts predict that the combination of a highly vaccinated campus population and proven public health measures—including indoor mask-wearing and surveillance testing—will minimize the risk of virus transmission and provide the safest possible environment for in-person instruction this fall.

“The predictions from the models that we’ve been looking at suggest that we’re really quite safe from large outbreaks,” Peter Frazier, the Eleanor and Howard Morgan Professor of Operations Research and Information Engineering in the College of Engineering, said during an August 11 town hall for faculty and staff.

Amid global concern about summer spikes in the coronavirus’ more contagious delta variant, the team’s models estimate that vaccines and other mandatory safety measures will substantially reduce the risk of infection and transmission.

VACCINES, MASKS, TESTING TO MINIMIZE RISK ON CAMPUS

In classrooms at full capacity, the risk of transmission from one masked, vaccinated person to another is estimated to be reduced by 99.5%, compared to the risk between unvaccinated occupants not wearing masks, Frazier said. While emphasizing that models always have uncertainty, he said that they estimate a total of two infections associated with classroom transmission across the entire student body over the course of the semester if masking requirements are maintained. No transmission was attributed to classrooms last year, but the number of in-person classes was far smaller.

The risk for vaccinated instructors is also estimated to be very low—about 1 in 10,000, which Frazier said is comparable to the chance of being struck by lightning during one’s lifetime and about 100 times smaller than the recent rate of infection reported in the

Ithaca area by the Tompkins County Health Department.

“Based on those numbers, I do think that it’s safe to hold class in person,” Frazier said.

He said the same safety measures that reduce risk for students and instructors would help protect other employees on campus as well: masks, vaccination rates much higher than the non-Cornell population, regular testing for certain staff, and avoiding close contact when practical.

A critical factor underpinning the models and planning is the excellent protection against infection or severe illness provided by vaccines, which are required for students (barring an approved medical or religious exemption) and have been adopted by faculty and staff at rates far higher than the general population.

As of Aug. 16, 95% of the campus community was fully vaccinated, according to the university’s COVID-19 tracking dashboard. The total includes more than 25,800 students and more than 11,800 faculty and staff, including 99% of faculty.

Research has shown vaccinated people are much less likely to become infected by the delta variant than unvaccinated people, Frazier said. While estimates vary, Frazier pointed to recent research in the journal *The Lancet* estimating that the Pfizer vaccine is about 80% effective against infection by the delta variant. And even if they do become infected, vaccinated people are significantly less likely than unvaccinated people to require hospitalization or transmit the virus to someone else, he said.

“The best thing that you can do protect yourself, but also to protect your family, is to get vaccinated,” Frazier said.

But because infection and transmission is possible, if much less likely, among the vaccinated, the university has instituted additional safety measures to start the semester: An indoor mask mandate in campus facilities, and surveillance testing covering a significant portion of the campus population — an estimated 25,000 tests each week.

Frazier pointed to research published in the journal *PNAS* in January 2021, before vaccines were widely available, suggesting that virus transmission between two parties is reduced by roughly 80% if just one is wearing a mask, and roughly 95% if both wear masks.

As an additional safety measure, unvaccinated or partially vaccinated undergraduate, graduate and professional students, as well as faculty and staff, will participate in surveillance testing twice weekly until fully vaccinated. In addition, many vaccinated



Peter Frazier, the Eleanor and Howard Morgan Professor of Operations Research and Information Engineering in the College of Engineering, speaks during an Aug. 11 town hall for faculty and staff.

students, faculty and staff will be tested weekly.

The university’s state-of-the-art surveillance testing program — a cornerstone of last year’s successful effort to minimize outbreaks when vaccines were not yet available — is expected to enable rapid identification, isolation and contact tracing for any positive cases, including asymptomatic cases and potential “breakthrough” infections among vaccinated individuals.

“The measures we have in place will be strong enough to prevent transmission from becoming widespread,” Frazier said, “and will substantially protect people that are interacting with students on campus.”

Frazier expects to see a bump in positive cases as students returning to Ithaca from around the country and the world are tested, then to see those numbers drop.

If the prevalence falls as expected and remains low, university leaders have said it might be possible to relax the masking requirement for vaccinated individuals this fall. But those decisions will continue to be guided by data, scientific research and guidance from national, state and local health departments, with policies adapting as conditions change.

“Even though things are a lot better, unfortunately the pandemic is not over, and we need to put these measures in place,” Frazier said. “With some modest changes to how we live — masking and getting tested — we can do most of the things we enjoy doing and continue to be safe.”

By James Dean

Note: This article was written before the emergence of the Omicron variant, which has changed things considerably.

Shane Henderson, the Charles W. Lake, Jr. Professor in Productivity, is using stochastic modeling and optimization to study new directions in emergency medical services, thanks to a grant from the National Science Foundation.

The nearly \$380,000 award will contribute to national and international health by developing new mathematical and computational tools to inform the design of so-called volunteer schemes for out-of-hospital cardiac arrest.

“Cardiac arrest arises when a patient’s heart enters an atypical rhythm,” said Henderson. “Death follows rapidly unless the patient receives medical attention. Lives can be saved if the patient receives cardiopulmonary resuscitation (CPR) quickly.”

Recently, volunteer schemes have arisen whereby volunteers install an app on their smartphone that tracks their location. Volunteers near a cardiac arrest are notified by the app and can choose to respond, thereby shaving valuable minutes from the response time, i.e., the time until quality CPR is initiated.

“Such schemes are emerging worldwide, but key questions relating to their design remain unanswered,”



Professor Shane Henderson

HENDERSON AWARDED NSF GRANT TO STUDY EMERGENCY MEDICAL SERVICES



A Tompkins County first responder checks his gear. (Photo courtesy of Tompkins Weekly)

Henderson said. “For example, how many volunteers are needed to ensure impact on survival rates, and when one can potentially recruit volunteers of multiple types, which should be prioritized?”

The proposed research develops methods to answer these questions and others related to the design of such schemes, with the potential to help usher in a new approach to emergency medical services, where ambulances for transport are paired with volunteers for rapid response, leading to improved medical outcomes at lower cost. Related research questions relate to the potential impact of broadband connections that enable a remote paramedic

or doctor to advise on-scene treatment by a paramedic or ambulance officer, and how to make dispatch decisions in periods when emergency services are severely loaded.

Henderson and Ph.D. student Maggie Li are actively working on these questions with collaborators in the Netherlands and New Zealand.

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Undergraduate research has returned with a flourish thanks to the efforts of our faculty members.