New scholarship program in mathematics is a success

Offers aimed at high-achieving students are accepted at a record-setting rate

By Joey Figueroa, LAS 11/7/16 and Math Times staff

One of the most important things the Department of Mathematics does is to enable excellent students to study mathematics at Illinois. This year, out of 25 offers, seven students accepted scholarships and joined the department as freshmen this fall.

The scholarship program has been an important project of the Mathematics Development Advisory Board (MDAB), a group of mathematics faculty, alumni, and friends that addresses departmental initiatives. The Board helped to raise funds for scholarships, and they have also advised the department about the configuration of scholarship offers. To recruit more top students, this year the Board recommended that the department focus on four-year, $6,000 per year scholarships, yielding the great results described above.

Lucas Trojanowski and Clara Yam pose in front of Altgeld Hall. They are among several high-achieving mathematics students who received reconfigured scholarships under a new program in the Department of Mathematics.

"Before that we had tried varieties of scholarship configurations," said Professor Sheldon Katz, chair of the MDAB. "Sometimes they were fewer than four years, sometimes less than $6,000. That way we offered more scholarships, but fewer of them were being accepted. So having this size and duration of scholarship really seemed to work." This year's 28 percent scholarship yield rate—the percentage of students who accept a scholarship and agree to attend—is an excellent rate for recruiting students who are at the top of their class.

For Lucas Trojanowski, a recipient of the Vincent O. Greene Scholarship in Mathematics, Illinois' offer was easy to accept because of the strong vote of confidence it provided him.

"My math scholarship has motivated me to do more with my education by constantly reminding me that I'm here to build a career and that I should do everything that I do with a purpose," Trojanowski said. "It also serves as a reminder that the University of Illinois believes that I can do great things, and it makes me feel like the school truly wants me to be successful."

Five scholarship titles were awarded to incoming students for the fall semester. Zhaohan He and Broderick Portell each received the Illinois Mathematics Excellence Scholarship; Trojanowski and Justin Black were both awarded the Vincent O. Greene Scholarship in Mathematics; Jonathan Alvarez received the Gail V. Kellogg Scholarship; Alice Chudnovsky earned the Ruth V. Shaff and Genevie I. Andrews Mathematics Scholarship; and Clara Yam was awarded the Susan C. Morisato Mathematics Scholarship.

Chudnovsky has used her award from the department as a means of motivation, especially as a minority in the field. "The scholarship pushes me to prove that…women are just as capable of doing mathematics, if not better, than men," Chudnovsky said.

Success brings a welcome challenge: raise more money for scholarships. The $168,000 commitment to the most recent group of students is a substantial increase over past years.

"To keep offering scholarships at this rate, we need to raise more money for scholarships," said department chair Matthew Ando. "Fortunately, we have wonderful students. Helping students like these is a compelling cause."

College of
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From the Chair

Dear friends,

In 2013, the National Research Council produced a national strategic plan for mathematics, called *The Mathematical Sciences in 2025*. It is an impressive and optimistic document, describing a discipline with broader reach and greater impact than ever before, while retaining the strength of its core. The current issue of the *Math Times* exhibits our department as fully engaged with that vision: our faculty, students, and alumni are doing great mathematics and changing the world.

Our faculty continue to do impressive work–and they are receiving international and university-wide recognition for it. The department's local and global impact extends well beyond the traditional classroom. Our online program NetMath is taking on many more initiatives, and our outreach activities are having a significant impact in the community. You can read about these accomplishments and more in this issue.

We also devote several pages to the Actuarial Science Program. In recent years the program has grown to over 300 undergraduate majors and about 40 Masters degree students. We are developing plans for an actuarial science concentration in our PhD program. The Actuarial Science Club is a wonderful model for student leadership in an academic program.

It is an increasing challenge to house so much activity in our aging buildings—and due to growth we now use space in a total of five buildings. Fortunately, the project to raise funds to renovate Altgeld and Illini Halls is progressing, and you can read about the campaign and its new website in these pages.

With so much to offer, we are pleased that our scholarship program is enabling wonderful students to choose Illinois. As you can read in our cover story, we have moved aggressively to award the scholarship resources we have. I thank our scholarship donors for their support of our students. To all, please consider supporting Mathematics scholarships so that together we can invest in the next generation of Illinois mathematicians.

Matthew Ando
Professor and Chair
Department of Mathematics

Look for "Illinois Department of Mathematics" on Facebook and LinkedIn to get the latest news and find out about upcoming events. And take a look at our photo albums!

Daniel Zaharopol

by Jim Dey

Halfway through his doctoral studies in mathematics at the University of Illinois, Dan Zaharopol decided to stop studying math for its own sake and devote himself to math education for others' sake.

So, after getting a master's degree in 2008, Zaharopol moved to New York City to establish educational programs aimed at identifying under-privileged children with a talent for mathematics.

"A lot of these kids who come from difficult circumstances succeed in remarkable ways. That's really important to get across," said the 34-year-old Zaharopol. "With mentoring and support, they can achieve phenomenal things."

As the founder and executive director of Bridge to Enter Advanced Mathematics (BEAM), Zaharopol presides over a program that has grown from a $100,000 budget in 2011 to a $1.1 million budget generated by grants and gifts, and six full-time employees today.

BEAM's first class of seventh-graders in 2011 now is in its first year of college. It started with 17 students, the vast majority of whom are now college freshmen. Its current class of seventh graders, drawn from New York City schools, numbers 80.

Zaharopol's interest in mathematics and education stems, at least in part, from his parents, both of whom are teachers. Immigrants to the United States from Romania through Israel, His family came here in 1984, when he was two. His mother taught English in Romania and Israel and studied comparative literature. His father taught mathematics at the State University of New York in Binghamton.

Growing up, Zaharopol had what he calls a "very natural interest in science and math." "I'm sure my father played a part, but what I really remember is reading *Discover* magazine as a kid and wanting to be involved in science like that," he said. Ultimately, Zaharopol became hooked on the problem-solving nature of mathematics.

"I really like the way it makes you think. I find it's a window into human thought. I like grappling with different problems and then finding things deeper within and putting them together to understand why something is true," he said.

Zaharopol did his undergraduate work at the Massachusetts Institute of Technology. After narrowing his choices for graduate school to the UI and Northwestern, he chose the UI. He said Champaign-Urbana reminded him of Binghamton, and he was impressed by the math department's atmosphere.

"I liked the people and the very friendly environment," Zaharopol said. "I wanted a place where I could find friends and where the professors would be supportive."

Daniel Zaharopol (MS 2008), founder and executive director of Bridge to Enter Advanced Mathematics (BEAM).

His area of interest was algebraic topology, a branch of mathematics that uses tools from abstract algebra to study topological spaces.

Eventually, he was pulled in a different direction, "I left the UI because I knew I wanted to pursue the field of math education," he said.

What was his motivation? "I think education is the key to human advancement, and I've had a lot of success whenever I taught," said Zaharopol.

Two other factors come into play. He said the United States needs more students studying math-based subjects. "There's a huge shortage of people trained well in mathematics who can do things in math, science and engineering," he said. The other is the need to identify talent among young people from lower-income families and introduce them to new opportunities.

"I think it's really important for society that people from all walks of life can enter STEM careers (science, technology, engineering and math). So we work to make that possible," he said, noting that BEAM is "focused on developing people who might really excel."

BEAM has partnerships with 35 New York City middle-schools and starts with a pool of 5,000 students. Five hundred take tests designed to reveal whether they have math skills regardless of their previous math education, generating the current crop of 80 seventh graders. Once identified, BEAM enrolls its students into a four-week summer math class and then offers programs during the school year that include online classes.

"We work with them for the next five years," Zaharopol said of BEAM's effort to produce college freshmen prepared to go into math-related fields.

He said it "feels good" to see students in the BEAM program excel and that he has ambitions to see the program expand further into New York City and beyond. "But we want to make sure we grow at a pace where we can maintain the quality of the program," Zaharopol said.

As for that doctorate he once pursued, it's no longer on his to-do list. "I'm pretty enmeshed in what I'm doing now," Zaharopol said.

Jim Dey is a columnist and editorial writer for The News-Gazette *in Champaign-Urbana.*

Geometric application of the container method

by Professor József Balogh

Paul Erdős was a great master of proposing problems that people without mathematical skills could easily understand, but the problems are hopeless or solving them is possible only using deep mathematics. One of his favorite topics was elementary plane geometry. Here we discuss one of his favorite geometric problems that he widely advertised in the 1980s:

> A point set in the plane is in *general position*, if it contains no three points in a line. If r points are in a line, then they form a *collinear r-tuple*. Let S be a collection of n points in the plane and denote $g(S)$ the largest size of a subset of S, which is in a general position. What is the minimum value of $g(S)$, considering every n element point sets S?

The answer is obviously 2, if the points of S are on one line, then at most two points of S can be chosen in a general position. To avoid this trivial answer we consider sets S with no four points of S in a line. This is exactly the question that Erdős asked. Let $g(n)$ be the minimum of $g(S)$ over all such point sets S. It is reasonably easy to prove that $g(n) \leq (2n)^{1/2}$, but to get slightly better bounds Zoltan Füredi in 1991 already used deep theorems. His result is that $\sqrt{n} \cdot \log n \leq g(n) = o(n)$, where $o(n)$ means that $g(n)$ grows sublinearly.

Recently, jointly with Solymosi, we proved that $g(n) \leq n^{5/6}$. Giving an upper bound on $g(n)$ means that we prove the existence of a point set S consisting of n points in the plane, containing no collinear 4-tuple, with the property that every subset of S of size $n^{5/6}$ contains 3 points in a line.

We set $m \approx \sqrt{n}$, and start with $[m]^3$, the 3-dimensional integer grid of side length m. This contains about m^6 collinear 4-tuples of points. We sparsen this point set, we keep each point with probability p, where $p \approx 1/m$. After this sparsening only 'few' collinear 4-tuples are remaining, removing a point from each keeps most of the remaining points. With high probability we have now about $n = m^2$ points, no four of them in a line. These points are in 3 dimensions; a random projection can map them into the plane, keeping the collinearity of point tuples, i.e., no new collinear 4-tuple of points are created, while the projection keeps collinear 3-tuples collinear. To justify rigorously that it does not have a large subset in general position we use the so-called "container method."

In 2015, Robert Morris, Wojciech Samotij (my then PhD student) and I, and independently David Saxton and Andrew Thomason, developed the theory of "containers."

A *k-uniform hypergraph* is a family of k element subsets, *hyperedges*, of an underlying set, which for our problem will be the points of $[m]^3$.

For our geometric problem we form a 3-uniform hypergraph, where the underlying set is $[m]^3$, and 3 points form a hyperedge if they are a collinear 3-tuple. A subset I of the underlying set is an independent set, if it does not contain a hyperedge. A point set in general position is an independent set, as it does not contain 3 points in a line. In other words, in hypergraph language, we have to construct a *geometric* hypergraph, which has only small independent sets. The general container theorem states the following about *nice k*-uniform hypergraphs (note that most natural hypergraphs are *nice*).

Theorem. For every k-uniform hypergraph there exists a family of *containers* $C_1, \ldots, C_t$ of subsets of the underlying family with the following properties:

(i) The number of sets, t, is *small*.

(ii) Each set C_i is *small*.

(iii) For every independent set I there is a C_i that $I \subset C_i$.

Property (i) is important, otherwise, each of the independent sets could be listed; (ii) is important, otherwise the entire underlying set could be chosen as one container, containing all the independent sets. Certainly, (iii) is the property which is the "container" property. Because there are many mathematical objects, such as point sets, arithmetic progressions and graphs, that can be modelled with hypergraphs, this highly non-trivial theorem has many applications, it led to the solutions of couple of problems of Erdős, and many other mathematicians.

We use this method for the geometric set-up as follows: We have the 3-uniform hypergraph with underlying set $[m]^3$. The independent sets could be covered with 'few' container sets. When we take a random subset of points, with density p, then as there were only 'few' containers, each will contain only p-density of the remaining points. If an independent set remains in the p-random subset of points, then it has at most $p \approx 1/m$ times the size of a maximum container set many points (which is now $m^{8/3}$), which gives our upper bound $m^{8/3} \cdot [m]^{-1} = n^{5/6}$ on the maximum size of an independent set.
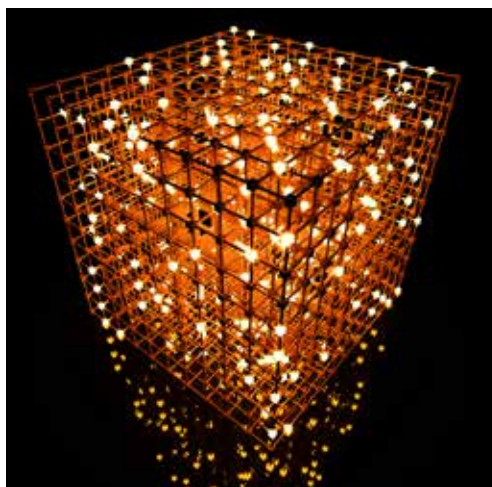
József Balogh (PhD 2001 Univ of Memphis) joined the department in 2005. He was named a Simons Fellow and Marie Curie Fellow in 2013-14, received an NSF CAREER Award, and received the 2016 George Pólya Prize in Combinatorics.

Jake Akstins

by Jim Dey

Unlike some mathematicians, Jake Akstins doesn't appreciate mathematics for the pure beauty of it, but instead for the practical ways it affects people's lives.

That's why he decided to major in actuarial science and minor in business at the University of Illinois.

Jake Akstins, actuarial science major.

"You can use math to price real things," said the 20-year-old Akstins, a junior from Homer Glen in Will County.

That's what he learned last summer while participating in a summer internship program for the CNA Financial Corp. in Chicago. Working on issues like workers' compensation and cyber-risks, Akstins was fascinated by addressing the tangible problems posed by producing affordable insurance products that still generate a profit for the company.

"I'm very interested in examining real live things and determining the probability and chances and risks that go with them," he said.

It's an interest that goes back almost as far as he remembers. Akstins specifically recalls a lesson in first grade; he surprised his teacher with a negative answer when she misspoke (putting a smaller number before a larger number in a subtraction problem). Later, he said, his mother noticed his curiosity about the subject and urged him to join with her as she studied math.

"She would ask me questions about math and help me learn," he said. "When she was studying calculus, she would teach it to me."

Akstins' mother is a teacher in the STEM (science, technology, engineering and mathematics) field while his father, a onetime carpenter, is a construction superintendent. The youngest of three, he has a brother and a sister.

By the time Akstins was high school age, he enrolled at the Illinois Math and Science Academy in Aurora, a residential high school for the state's best and brightest students. He said the advanced math classes he took there made it possible for him to accelerate his education in actuarial science, a subject dealing with the measurement and management of risk and uncertainty.

Aspiring actuaries must take a series of 10 tests to earn that designation. Akstins took his first after his freshman year and his second after his sophomore year, something he said he could not have done if he had not gone to a high school that emphasized advanced math education.

"My goal was to begin the exam process earlier than the norm at Illinois. It helped me get my foot in the door for my internship," Akstins said.

Once he decided to become an actuary, he said enrolling at the UI was a natural choice to make.

"It has a very good actuarial science program. Plus, it was convenient," he said. "I feel that by going to school here, I have a fun college experience while being in a top-tier program."

He identified two faculty members as being particularly helpful. Akstins said Professor Alexey Stepanov in the Department of Statistisc, from whom he's taken three classes, offers a "lot of humor and very practical teaching," and Rick Gorvett, the former director of the Illinois Actuarial Science Program, provided sound and candid advice.

Needless to say, Akstins has excelled at the UI. In addition to an internship at CNA, he was awarded a State Farm Actuarial Science Scholarship and is vice president of the Actuarial Science Club. Akstins said the group makes it a point to have fun but focuses much of its attention on "getting people jobs."

The club invites company representatives to make presentations and acts as a go-between to set up students with mentors.

"We are the only club, to my knowledge, that runs its own career fair," Akstins said.

Unlike many young people, Akstins has thought about where he'd like to go in his career and charted a career path. He plans to start as an actuary and then move into corporate management, perhaps getting a master's degree in business administration.

But that's a long way down the road. His short-term goal is to do a second internship in summer of 2017 at CNA before graduating and moving into the business world.

In the interim, Akstins spends his time like other UI students, hanging out with friends and keeping track of his favorite baseball team—the Chicago White Sox.

He said baseball and its mountain of statistics it produces help sustain his interest, even in bad years. A former player and umpire, Akstins said, "I also just like to watch it."

Jim Dey is a columnist and editorial writer for The News-Gazette *in Champaign-Urbana.*

Strom Borman
Assistant Professor (PhD 2013, University of Chicago)

Matthew Strom Borman grew up near Chicago and Minneapolis and received his BA at Reed College in Portland. He then came back to the midwest to get a PhD at the University of Chicago, doing research in symplectic topology and geometry under Leonid Polterovich and Shmuel Weinberger. Before coming to Illinois he was an NSF postdoctoral fellow at Stanford University and a member at the Institute for Advanced Study. He enjoys playing hockey, going for bike rides, and watching films.

Strom Borman

Christopher Dodd
Assistant Professor (PhD 2011, MIT)

Christopher Dodd grew up in Washington D.C. before going on to undergraduate studies at the University of Chicago, and completing his PhD at MIT under the supervision of Roman Bezrukavnikov. He did postdoctoral work at the University of Toronto, MSRI, and the Perimeter Institute. His research is in algebraic geometry and geometric representation theory; focusing more recently on positive characteristic and p-adic techniques. He lives in Urbana with his wife, son, and a puppy whom he enjoys walking around the neighborhood.

Christopher Dodd

Emily Cliff
J.L. Doob Research Assistant Professor (DPhil 2015, University of Oxford)

Emily Cliff grew up in Edmonton, Canada, where she studied for her BA in linguistics and mathematics at the University of Alberta. After deciding to focus on pure mathematics, she moved to the University of Toronto to complete her MSc, and then to Oxford to work on her DPhil under the supervision of Kobi Kremnizer, on chiral and factorization algebras and factorization spaces. She worked for a year in Oxford as a junior research fellow in geometry and representation theory before coming to Illinois. When not learning about math, Emily has been learning to play the cello (for the last year) and to do karate (for the last twenty-one years). She also enjoys cooking and crafts such as knitting and quilting.

Emily Cliff

Erik Walsberg
J.L. Doob Research Assistant Professor (PhD 2015, UCLA)

Erik Walsberg was raised in Pheonix, Arizona. He did his undergraduate degree in mathematics at Arizona State University. He then moved to Los Angeles, where he did his PhD in the UCLA logic group under the supervision of Matthias Aschenbrenner. He then spent a year as a postdoc at the Hebrew University of Jerusalem, although he was physically in Paris during that time. His research is in model theory, in particular model theory over the real line. He has also dabbled a bit in metric geometry.

Erik Walsberg

Ying Wang
J.L. Doob Research Assistant Professor (PhD 2016, University of Waterloo)

Ying Wang received her BS in pure and applied mathematics, a BA in economics, and an MS in probability and statistics in China before she began her PhD in actuarial science at the University of Waterloo. She did research on the pricing and hedging for the variable annuities for her master's degree, and then worked on the risk measures and capital allocation principles for risk management as a research assistant in Waterloo during which time she also obtained the designation of Associate of the Society of Actuaries (ASA) there. The research topics that she is focusing on now are new risk measures, capital allocation principles and related applications. Besides her actuarial research interests, Wang likes painting, baking and traveling. She also welcomes students to ask her about the SOA exams since she is always ready to help.
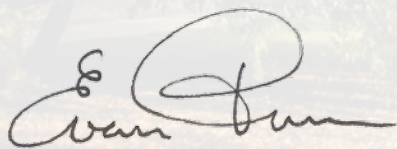
Ying Wang

Opportunities in Mathematics

The Department of Mathematics welcomes its new development officer, Evan Tammen. In his role, Evan travels throughout the country engaging with our alumni and friends, garnering support for Mathematics at Illinois. Should you have questions about our current needs information or about other departmental funding priorities, please reach out to him at etammen2@illinois.edu or (217) 300-5114. Your gift will help our department reach a new level of excellence in teaching and innovation.

As our campus prepares for its 150th anniversary, we, as a department, reflect upon our achievements while looking to the future with excitement. Since 2012, the department has committed over $300,000 to fund 28 of its most meritorious undergraduate students. Thanks to your support, Mathematics provided a record-breaking amount of scholarship funding to its incoming freshman this year. This scholarship initiative was pioneered by our Mathematics Development Advisory Board (MDAB), and together with department chair Matthew Ando, MDAB chair Sheldon Katz, undergraduate director Randy McCarthy, and emeritus professor A.J. Hildebrand, our yield rates of top undergraduate mathematical talent have increased year after year. Mathematics at Illinois continues to attract the best and brightest, bringing excitement to our classes and enhancing learning for all students.

As we reflect on our historic past while planning for a bright future, we embark on our Campaign for Altgeld and Illini Halls. These buildings evoke images and memories of Illinois' formative era, but they need renovation, expansion, and modernization. The entrance to Altgeld Hall, when paired with our beloved alma mater, forms one of the most recognizable and iconic snapshots of our institution. Nathan Ricker, its principal architect, was a professor at the University of Illinois where he received his architecture degree and the distinction of being the first person to receive a degree in architecture in the United States. The building served as the campus' first library and later housed its presidents. We are reminded of our historical greatness as we contemplate this impressive structure but are also called to act in order to support generations of proud Illini to come. To learn more about the project, please visit the new website: www.altgeldillini.illinois.edu.

We invite you to consider the many opportunities and to imagine, with us, what else we can accomplish together. Whether you are interested in contributing to help renovate our facilities to better accommodate our unprecedented enrollment, supporting our most distinguished Actuarial Science students as they take professional exams, or helping us fulfill our land-grant mission by supporting our summer youth campers, know that you are investing in a brighter future for Illinois students. We thank you wholeheartedly for your generous support.

Evan Tammen, Assistant Director of Development, College of Liberal Arts and Sciences.

Current needs you can help with

➢ **Actuarial exam reimbursement**: $250 provides reimbursement to one undergraduate student for one actuarial science exam fee

➢ **Student travel**: $500 covers the typical cost of travel to a research conference for one graduate student

➢ **IGL research**: $1,000 supports one undergraduate student's research for one semester in the Illinois Geometry Lab

➢ **Undergraduate actuarial science research**: $1,500 funds one student to work under the Actuarial Science Undergraduate Research Program

➢ **Undergraduate summer research**: $1,500 funds one undergraduate student to work on a research project for the summer

➢ **Graduate summer research**: $2,000 supports one month of summer research for a graduate research assistant

➢ **Youth summer camp**: $3,000 provides meals and refreshments for 50 youth campers for two weeks of our Summer Illinois Math Camp

➢ **Visiting Professor**: $7,250 provides the balance needed to hire a distinguished Visiting Professor in Spring 2017

www.math.illinois.edu/gifts

Students gain experience with industry through conferences and research programs

Midwest Actuarial Student Conference

Nimesh Avashia, Dave Kester, Gabby Kane, Emily Knapp, and Anika Newaz (pictured at left) attended the Midwest Actuarial Student Conference (MASC) hosted by DePaul University in Chicago on October 22, 2016. These U of I students were able to attend with support from the Actuarial Science program at Illinois.

MASC provides students in actuarial science with the opportunity to network with peers as well as meet industry professionals and learn from their experiences. Sessions at the conference provided students with insights into career options as actuaries, strategies for searching for jobs and tips for successful interviewing.

"MASC helps ensure that our graduating students are as informed as they can be about the options available to them as new actuaries. We hope to continue the tradition of this conference when we host it again in a few years," said U of I actuarial science advisor Corrie Proksa.

CAE Student Summit

The 2016 Center of Actuarial Excellence (CAE) Student Summit, held in Chicago this past August, gathers top students from CAE universities together with Society of Actuaries (SOA) industry leaders. Representing the University of Illinois at the summit were seniors Christopher Moon and Alice Chi. Direct interactions with actuarial leaders, such as SOA president Jeremy Brown (pictured at right), at an early stage of their careers is a valuable learning experience.

One of the most pressing topics of the summit was the upcoming curriculum changes to the SOA's exam system. The first curriculum changes will take effect July 1, 2017. Some of the material on the Financial Mathematics exam will be moved to the Models for Financial Economics exam, some of the material from Models for Financial Economics will be moved to upper-level exams, and two new exams, with a focus on applied statistics and data modeling, will be created.

Photo courtesy of the Society of Actuaries.

Actuarial science undergraduate research program

Titan Wibowo, an actuarial science major, participated in the Actuarial Science Undergraduate Research Program during Fall 2016 semester. "Being a part of this research program has been an awesome experience for me. This semester I am researching the "Optimization of Reinsurance Strategies" which may help insurance companies minimize the most risk at the lowest cost.

Through this project, I have been exposed to reinsurance strategies and premium principles academicians and practicing actuaries use to re-insure risks, and this gives me a feel of what I will be doing in the future as an actuary. Later in the project we might start coming up with our own optimal reinsurance strategy, and this is really something I am looking forward to. All in all I am grateful to be part of an amazing actuarial science program and this eye-opening research project."

New initiatives in Actuarial Science program

This year the Actuarial Science Program at Illinois witnessed big changes to the program. Rick Gorvett, Director of Actuarial Science Program from 2003-2016, left Illinois this past January to become the first staff actuary of the Casualty Actuarial Society. Over the past decade the program has flourished under his leadership and established itself as one of the leading programs in the property and casualty area. We thank him for outstanding contributions to the Illinois program.

With strong support from the department, two new members were recently recruited to the program. Ying Wang (ASA), a J.L. Doob Research Assistant Professor, who recently graduated from the University of Waterloo, broadened our scope of research expertise in quantitative risk management. Corrie Proksa (FSA) an academic adviser, previously worked as a health actuary at Deloitte and Aon Hewitt and she brings extensive industry experience. Under the direction of Associate Professor Runhuan Feng (FSA, CERA), serving as Interim Director of the program, and Assistant Professor Shu Li, the program will undertake exciting curriculum developments and bring new initiatives to our program.

Top national honors

The Casualty Actuarial Society (CAS) selected the University of Illinois at Urbana-Champaign as a recipient of the 2016 CAS University Award, recognizing its exemplary work in preparing students for a career in the property and casualty insurance industry.

Illinois has 430 total students in its actuarial science program, with two faculty members, Feng and Li, teaching actuarial science courses exclusively. Illinois impressed the award panel for its focus on property and casualty insurance across multiple areas including curriculum, research, industry engagement, and innovation. The selection process for the first annual CAS University Award Program was extremely competitive, with 24 schools throughout North America, Asia, and Australia being considered for the award.

In addition, the Actuarial Science Program at Illinois has been ranked #2 by the Online Accounting Degree Programs (OADP) as one of the best values in Bachelor of Actuarial Science degree programs in 2016. The ranking was based on graduation rate, quality of curriculum, student appeal, net price, and the distinction of being designated a Center for Actuarial Excellence by the Society of Actuaries. OADP noted that "The university has a particularly strong record of achievement in the areas of probability and statistics, which has had a significant effect on the quality of its undergraduate actuarial science program."

Program highlights

➢ A new PhD concentration in Actuarial Science and Risk Analytics, preparing students for research and development careers in financial service and risk management industries, is being developed.

➢ Starting in 2017, the program will roll out two new courses: *Risk modeling and Analysis*, focusing on copula and multivariate risk modeling, and *Stochastic Processes for Finance and Insurance*, providing foundations for advanced probability modeling.

➢ We are currently working with the State Farm Research and Development Center to introduce in-class computational case studies in the course on loss models. The case studies will enable our students to learn statistical software packages as well as to apply theory directly to real-world business problems.

➢ The program received major funding from the Society of Actuaries to launch an "Undergraduate Research Program in Risk and Actuarial Science." The program has been successful with 31 students participating in 10 research projects in 2014-2015 and 51 students participating in 11 projects in 2015-2016. The program provides actuarial science undergraduate students with an opportunity to perform and disseminate research and to develop their skills in research methodology, project management, writing, and presentation. One group of students presented their research findings at the University of Illinois Undergraduate Research Symposium.

➢ After a rigorous review process, the SOA has confirmed that our designation as a Center of Actuarial Excellence has been renewed through 2020.

Actuarial Science Club opens doors for students

By Joey Figueroa, LAS 9/14/16

When Karen Liu first arrived at Illinois as a freshman, she wasn't sure what she wanted to do when she graduated. But when she and her parents mulled over the top job listings for mathematics majors, actuarial science caught their attention. Like most, Liu wasn't familiar with actuarial science. But she took a chance on it.

Now a senior, Liu has never been more certain that the field she selected was the right one, and being in the U of I Actuarial Science Club since her freshman year is a big reason why. She is now president of the club.

The club was organized as a resource for the roughly 340 actuarial science undergraduate majors on campus to meet other students in their field and make meaningful connections in the corporate world years before graduating. Through weekly social and networking events, the club helps give students a sense of direction in an important field.

The Actuarial Science Club routinely holds networking events with various insurance and financial corporations throughout the year. Companies such as CNA Financial and Blue Cross Blue Shield visit campus to look for prospective actuaries to employ.

Matthew Ando, chair of the Department of Mathematics, believes the Actuarial Science Club can make a difference for students looking to put their mathematical and statistical skills to work.

"I think the students really feel like they are part of the whole enterprise and they have significant ownership of what happens in the program," Ando said.

According to a recent departmental survey, more than 90 percent of domestic students with an actuarial science degree from Illinois have secured a job in the field. The Actuarial Science Club makes findings those post-grad opportunities even easier.

"We just have a really good recruiting process," Liu said. "It is beneficial to be near Chicago. I know a lot of big companies that recruit for actuarial science will come down for presentations and come down for our career fair. We help members prepare for that."

Liu and the rest of the club's 11-member executive board (pictured above) were busy throughout the first few weeks of the fall semester. The club held a barbecue for freshmen and transfer students, and on Quad Day the club saw a lot of interest, with about 100 prospective members leaving their contact information.

Perhaps the club's most important event is the Meet the Firms night in late September, when dozens of companies from Chicago and surrounding areas come to campus for an actuarial science-specific career fair. The club holds a mock Meet the Firms the week prior in order to prepare the newer members on how to properly network and build resumes.

Along with the professional and networking benefits, the club organizes social events such as picnics and barn dances to build camaraderie, while also establishing study sessions and exam preps to help students succeed in class.

Actuarial science majors: we want to hear from you!

We appreciate hearing from our alumni. Let us know of your achievements after graduation! Please contact us at actuarial-science-director@illinois.edu.

Be sure to visit our new website
http://www.math.illinois.edu/ActuarialScience/

Campaign for Altgeld and Illini Halls underway

Altgeld Hall is easily recognized on the University of Illinois campus. It is a backdrop for the Alma Mater and a bridge between the College of Engineering to the north and the Main Quad to the south. Every day thousands of students take classes there and thousands more hear concerts ringing from its chimes.

The renovation and restoration of Altgeld and Illini Halls will restore a campus icon to its original splendor and transform what the Departments of Mathematics and Statistics are able to accomplish:

- Dynamic, new collaborative spaces will enable exploration and innovation in research and teaching.
- New and modernized classrooms will meet growing student demand. The classrooms will be designed to accommodate interactive learning and adapt to ever-changing technology.
- The buildings will be made accessible to all students.

Students from all colleges attend class in both Altgeld and Illini Halls—each year approximately 19,000 students take classes in these buildings. The Departments of Mathematics and Statistics offer undergraduate majors in actuarial science, mathematics, statistics, math and computer science, and statistics and computer science. Together these majors enroll more than 1,800 students, an increase of 80 percent in the last 10 years.

Neither building has seen significant renovation since 1956, while the face of public higher education has changed dramatically since then.

Illini Hall will be transformed into an entirely new space for collaborative discovery and learning. New common areas and

Altgeld Hall

enriched learning spaces will foster the increasingly interactive and interdisciplinary nature of research and teaching in mathematics and statistics.

The renovation of Altgeld Hall, including its magnificent library, will restore this landmark, returning the mosaics, murals, woodwork, and pink sandstone exterior to their proper condition.

A second elevator will be added to make all portions of Altgeld Hall accessible. Heating and air conditioning will be replaced throughout the building, vastly increasing energy efficiency, improving the classroom environment, and protecting the valuable collection of the Mathematics Library.

The projected cost of the renovations is expected to be between $90 million and $100 million. Funding will come from the state, campus and the generous support of alumni, friends, and corporate donors.

For more information about the Campaign for Altgeld and Illini Halls and how you can help, visit the campaign website.

CAMPAIGN FOR
ALTGELD
AND **ILLINI**
HALLS

altgeldillini.illinois.edu

Illini Hall

Reconnect at the mathematics PhD reunion

PhD REUNION
Sept 15-16, 2017

The Department of Mathematics at Illinois will hold a reunion for PhD alumni on Friday, Sept. 15 - Saturday, Sept. 16, 2017.

Reconnect with former classmates and teachers, and enjoy a variety of activities including campus tours, career panel, talks by current graduate students and keynote speakers, and the department's annual picnic.

Visit the reunion website for registration and accommodation information: www.math.illinois.edu/reunion/.

Erdős' Large Prime Gap Problem solved

This past March, at a number theory conference at the University of Florida, alumnus (PhD 1994, Halberstam) and current faculty member Kevin Ford was presented with a special award. It is a check for $1,250 and signed by Paul Erdős (1913–1996), part of a prize which Erdős offered for the solution of a problem about large gaps between consecutive prime numbers and which had been an open problem for more than 75 years. The total prize of $10,000 was split between Ford and

Prize check signed by Erdős.

his co-authors Ben Green (Oxford), Sergei Konyagin (Moscow) and Terence Tao (UCLA), together with James Maynard (Montreal; currently Oxford) who solved the problem independently at the same time. The two papers were posted to the arXiv in August 2014, and have now appeared in the *Annals of Mathematics*.

One the 20th century's pre-eminent mathematicians, Paul Erdős was also famous as a prolific problem poser, who often offered prize money for their solutions, with the amount dependent on his assessment of their difficulty. The award was presented by Erdős' long-time friend Ron Graham, who has established a special fund for these prizes.

The irregular behavior of prime numbers makes many innocuous claims about them notoriously difficult to prove—the famous and still unsolved twin prime conjecture being one example. The list of primes

2, 3, 5, 7, . . . , 109, 113, 127, 131, . . . , 9547, 9551, 9587, 9601, . . . , 492103, 492113, 492227, . . .

occasionally has unusually large gaps (highlighted in red). The gaps become arbitrarily large, for example $n! + 2, n!+3, . . . , n!+n$ are clearly all composite for any integer n. But how large can a gap between consecutive primes p', p be as a function of p? In 1938, Robert Rankin showed that the gap is often as large as
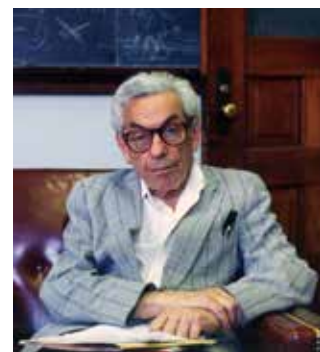
$$c \, \frac{\log p \, \log \log p \, \log \log \log \log p}{(\log \log \log p)^2}$$

for some positive constant c. The constant c was improved in subsequent years (including by Rankin himself), but not the order of growth, and in 1979 Erdős offered his prize to show that the constant c could be taken arbitrarily large. The papers of Ford-Green-Konyagin-Tao and Maynard accomplish this, but neither gives an *explicit* rate of growth for c in terms of p. A subsequent paper of Ford with Green, Konyagin, Maynard and Tao establishes that the gap can be as large as

$$c' \, \frac{\log p \, \log \log p \, \log \log \log \log p}{\log \log \log p}$$

for some positive c', a function tending to infinity (barely) faster with p.

Paul Erdős was a frequent visitor to the University of Illinois, as a G. A. Miller Visiting Professor in the Spring 1966 semester, and gave the 1979 Arthur B. Coble Memorial Lectures. In 1991, he was awarded an Honorary Doctorate from the University of Illinois for his many contributions

Paul Erdős in Altgeld Hall.

to several areas of mathematics. He wrote joint papers with many members of the department, including Paul Bateman, Harold Diamond, Zoltán Füredi, A.J. Hildebrand, Alexandr Kostochka, Bruce Reznick, Lee Rubel, John Selfridge and Douglas West.

Ford had previously solved a number of other Erdős problems, including finding the exact order of the number of distinct products in an $N \times N$ multiplication table (a problem of Erdős from 1955), and solving an Erdős problem about covering congruences (a $100 prize problem), together with Michael Filaseta (UI PhD 1984, Halberstam), Sergei Konyagin, Carl Pomerance (UI Visiting Associate Professor 1978–79) and Gang Yu.

Ford also has a story from his days in graduate school about Erdős related to the large prime gap problem.

"I was toying around with gaps between the numbers that are relatively prime to a given integer, and I asked Heini Halberstam if anyone had studied the problem before. He suggested that I write to Erdős, and I asked him for Erdős' email address. The look he gave me was classic. 'You must write him a letter', Heini told me, and fortunately he knew where Paul was at that moment."

One of Erdős' eccentricities was not having a permanent home, constantly traveling to one place or another for conferences or collaborations.

"A few weeks later I received a nice reply from Erdős. He explained what was known about the problem, with references. It turned out that my problem was intimately connected with large gaps between primes," said Ford.

Balogh receives 2016 Pólya Prize in Combinatorics

Professor József Balogh has received the 2016 George Pólya Prize in Combinatorics awarded by the Society for Industrial and Applied Mathematics (SIAM) at the annual meeting held in Boston this past July. Balogh joined the department in 2005. He was named a Simons Fellow and Marie Curie Fellow in 2013-14 and was the recipient of an NSF CAREER Award in 2008-2013.

The prize is awarded every four years for a notable application of combinatorial theory, and is broadly intended to recognize recent work. The 2016 Pólya Prize was awarded jointly to Balogh, Robert Morris, and Wojciech Samotij (PhD 2010 Illinois) and to David Saxton and Andrew Thomason for their path-breaking work on the container theorem and its applications.

Balogh, Morris, and Samotij published their work in the article, "Independent Sets in Hypergraphs," in *Journal of the American Mathematical Society* 28 (2015). Saxton and Thomason independently published this result in the article, "Hypergraph Containers," in *Inventiones Mathematicae* 201 (2015).

With a suitably defined notion of containment, the container theorem states that there exists a small collection of vertex subsets (containers) in an r-uniform hypergraph such that every independent set of the hypergraph is contained within a subset in the collection, with no subset in the collection inducing too many edges. Learn more on page 3 of this issue in the research highlight by Balogh.

This theorem has led to new proofs of several classical results in graph theory and number theory, lower bounds on the list chromatic number of hypergraphs, a proof of the conjecture of Kohayakawa, Luczak and Rodl, and has become an important tool for obtaining additional results in these and other areas.

Unexpected opportunities in mathematics

By Bruce Reznick
Professor, Department of Mathematics

Last February, I flew 10,000 miles to the beautiful tropical island nation of Mauritius, in the Indian Ocean east of Madagascar, to participate in the award ceremony for a math contest whose questions I'd written. The contest was a big deal there, and the ceremony was covered by the local newspaper and tv station.

A majority of the population of Mauritius is descended from South Asians who were brought in to work the sugar plantations in the 19th century. Inspired by a television documentary on the mathematician Srinivasan Ramanujan, Dr. Sattianathan "Sach" Sangeelee, a Mauritian physician working in Great Britain, organized the Ramanujan Contest, so as to inspire young Mauritians to consider careers in mathematics and the sciences. Sach contacted Professor Bruce Berndt (Professor of Mathematics at Illinois) to find a potential problem-setter, and Berndt talked to me. I constructed an exam in which more than half of the questions were simplifications of problems which Ramanujan had sent to the *Journal of the Indian Mathematical Society* more than a century ago.

The invitation to Mauritius was unexpected, arriving just before the New Year. It came with the chance for me to present the Ramanujan Memorial Lecture. I also had the pleasure of meeting Sach and Professor Muddun Bhuruth and the other members of the University of Mauritius (U of M) Department of Mathematics, which administered the contest to more than 200 students, a level of participation an order of magnitude higher than for the Putnam Competition in the U.S.

Winners of Ramanujan Contest and dignitaries at the award ceremony (Bruce Reznick is the fifth from the right).

The President of Mauritius, Dr. Ameena Gurib, was kind enough to meet with Sach and me at her office in Chateau-Le Reduit, an 18th century colonial mansion not far from the U of M campus. She was very pleased about the potential influence of the contest, which will become an annual event, on Mauritian students. She also talked about her academic specialty, the amazing biodiversity found in her country (see her TED talk online). Mauritius is a well-known tourist destination for Europe and Asia, but in the U.S. Mauritius may be best known as the home of the dodo.

I have been constantly surprised by the unexpected opportunities that mathematics has provided me over the years.

AMS names 2017 class of Fellows

Three faculty in the Department of Mathematics at the University of Illinois at Urbana-Champaign—Marius Junge, Rui Loja Fernandes and Alexandru Zaharescu—have been named Fellows of the American Mathematical Society (AMS) for 2017.   In its fifth year, the AMS Fellows program recognizes members who have made outstanding contributions to the creation, exposition, advancement, communication, and utilization of mathematics.

Junge was recognized for his contributions to the study of operator algebras, Banach spaces, harmonic analysis, and noncommutative probability, and for applications to quantum information theory. He joined the department in 2003. He was a 2011-2014 LAS Richard and Margaret Romano Professorial Scholar, and a 2010-2011 associate in the Center for Advanced Study.

Fernandes, who holds the Lois M. Lackner Professorship in Mathematics, joined the department in 2013. He was recognized for his contributions to the study of Poisson geometry and Lie algebroids, and for service to the mathematical community.

Zaharescu, who joined the department in 2000, was recognized for his contributions to analytic number theory. He received the 2010 LAS Dean's Awards for Excellence in Undergraduate Teaching, was a 2004-2005 and 2013-14 associate in the Center for Advanced Study, and has published some 300 papers.

A total of 23 faculty from the Illinois Department of Mathematics have been named AMS fellows since the inaugural class in 2013.

Faculty receive distinguished scholar appointments

The College of Liberal Arts and Sciences scholar appointments recognize excellence in our faculty. The Department of Mathematics has also established a named scholar program. These departmental named scholar appointments provide faculty with funds to support their research enabling them to do what they do best: generate exciting activity, support students, and solve important problems.

Pierre Albin, Runhuan Feng, and Kay Kirkpatrick have been named 2016-2017 Helen Corley Petit Professorial Scholars by the College of LAS. The Petit is awarded to junior faculty with tenure and promotion cases of "outstanding merit."

Pierre Albin (PhD Stanford) did postdocs at MIT, NYU/IAS, and Jussieu before joining the department in 2011. His research is in geometric analysis. He is particularly interested in analytic representations of topological invariants, analysis on non-compact or singular spaces, spectral geometry, heat kernels, and Dirac operators.

Runhuan Feng (FSA, CERA) joined the department in 2012 and is currently the interim director of the Actuarial Science Program at Illinois. He received his PhD from the University of Waterloo, Canada.   His research interest lies in actuarial/financial mathematics, applied probability and analysis.

Kay Kirkpatrick (PhD UC Berkeley), who has also been named a departmental David Blackwell Scholar in Mathematics, is a versatile mathematician who has made fundamental contributions in a variety of areas of probability theory including both classical and quantum statistical mechanics. She has also made contributions to the mathematical study of biology. She received an NSF CAREER award, and in Fall 2015 was an invited organizer of the program "New Challenges in PDE" at the Mathematical Sciences Research Institute in Berkeley, California.

József Balogh received a 2016-2019 J. Andrew and Susan Langan Professorial Scholar appointment from LAS. He received his PhD from the University of Memphis. He was named a Simons Fellow and Marie Curie Fellow in 2013-14, received an NSF CAREER Award, and received the 2016 George Pólya Prize in Combinatorics. His research interests are in combinatorics.

Kevin Ford, a leader in the field of number theory, has been named the departmental Heini Halberstam Scholar in Mathematics. He received his PhD from the University of Illinois at Urbana-Champaign. He was named an AMS Fellow in 2013 and recently Ford and his collaborators made substantial progress in the study of large gaps between prime numbers which led to solving a problem for which Paul Erdős offered a $10,000 prize for the solution (see article in this issue on page 12).

Vera Hur (PhD Brown Univ) has been named the departmental Philippe Tondeur Scholar in Mathematics. She is a leader in the field of differential equations, particularly the study of water waves. Hur has made fundamental contributions to the study of water waves, particularly to the study of vorticity and long-term stability. She was an Alfred P. Sloan Fellow, received an NSF CAREER award, and is currently a Simons Fellow.

NetMath program continues to grow

Mentor Excellence Awards

Undergraduate Mentors carry multiple responsibilities in NetMath: they guide students through NetMath self-paced courses and help them to stay on schedule, they hold online chat sessions and grade homework assignments, and provide online students with a peer connection to the University of Illinois. Each semester NetMath grants up to four undergraduate mentor awards. Please join us in congratulating the following Mentor Excellence Award recipients for spring 2016: Danielle Sponseller and Grace Sun (Outstanding Grading Pool Performers), Lianghao Cao (Best at Student Retention), and Nathan Cornwell (Outstanding Mentor Thoughts).

Uhl Scholarship recipients

The NetMath Jerry Uhl Scholarship is funded through an endowment from Professor Jerry Uhl. The scholarship covers tuition and fees for up to two NetMath courses. Award recipients are selected by committee on the basis of demonstrated financial need, academic potential and mathematical interest. Winners of the 2016 Jerry Uhl Scholarship are: Lucy Cho, Priyal Gosar, Julia Homola, Karla Perez, and Stephanie Sieben. All are high school students currently enrolled in Math 241 (Calculus III) with NetMath.

Summer semester courses

Thirteen Summer Term 2 courses were offered through NetMath this year. An addition to our open enrollment Academic Year term courses, these 8-week offerings are intended for UIUC matriculating students who require semester-based courses in order to qualify for financial aid. Our enrollment numbers show strong interest in these term-based online courses: 262 students took a NetMath summer term course in 2016.

NetMath Nexus

Under the lead of Faisal Whelpley, Associate Director of IT, Netmath is developing a web-based application called Nexus. Nexus will replace multiple software programs currently used to keep track of student progress in online courses and integrate them into a centralized resource. The web app will support administrative tasks and improve student services.

New partner schools

We welcome Lane Tech College Prep High School from Chicago, IL and Tianjin Foreign Language School from China to our Partner High School Program. Tianjin School is the first entry into our new International Partner High School (IPHS) program. Eleven students from Lane Tech are taking Calculus I, and six students from Tianjin School are taking Calculus III with NetMath this year.

Staff additions

NetMath is pleased to welcome three new additions to the program: George (Dave) Watson, E-Learning and Information Technology Specialist; Kerry Butson, Assistant E-Learning Specialist; and Janasia Sumlar, Office Support Associate. Dave Watson will be responsible for supporting curricular activities, maintaining specialized software and investigating new and emerging technologies for implementation in online courses. Kerry Butson will assist with development and maintenance of instructional materials, documentation to assist users with instructional tools, and conducting technology workshops for faculty and instructors. Janasia Sumlar will offer much needed support in the NetMath office to meet the needs of our growing number of online students.

Clockwise from top left: Jingyi Nie, Mitchell Almquist, Yike Xu, Benjamin Norton, Sarah Allen, Daniel Reeter, Mingrui Zhang, Rouyu Zhu, Padraic McSwiggan, Wanli Zhang, Xiao Jin, Aamodini Gupta.

Mathematics Ambassadors assist at department events

Meet our Mathematics Ambassadors! These twelve students were selected based on their strong academics, demonstrated leadership and involvement, and commitment to the department both while in school and as alumni.

Mathematics Ambassadors assist at a variety of events and have opportunities to network with alumni. This fall they helped at LAS Discovery Day, the Majors and Minors Fair, IGL at the Urbana Farmer's Market, the mathematics Corporate Forum and Career Fair, the department homecoming party, the Mathematics Development Advisory Board meeting, and various social events.
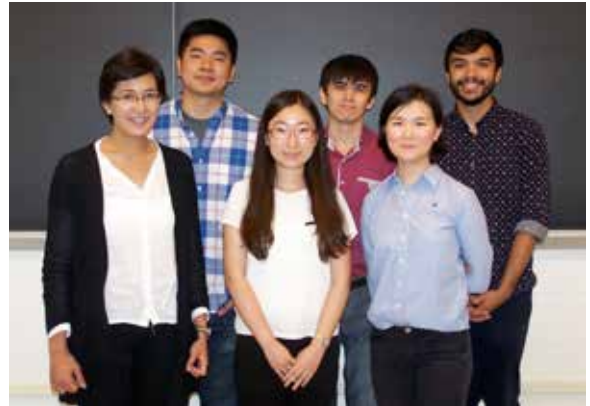
Student News

Summer REU program with NU expands

This summer, three students from Nazarbayev University (NU) in Kazakhstan joined three UI students to participate in a Summer Research Experience for Undergraduates (REU) program in Mathematics held at the University of Illinois.

The program was directed by Professors A.J. Hildebrand of the UI and Michael Santana (PhD 2016 UI) who served as a graduate assistant at last year's REU program and is now on the faculty of Grand Valley State University. The participation of the three UI students was made possible through support from the Department of Mathematics and its NetMath program; the NU students were funded from their own university.

The program featured a short course on topics in Applied Probability and Stochastic Processes; workshops on *Mathematica* programming; a series of career workshops; seminar talks by UI faculty and graduate students on their research; and other activities such as a tour of Wolfram Research headquarters.

REU participants (from left) Madina Bolat (NU), Khoa Tran (UI), Qingci An (UI), Daniyar Omarov (NU), Laila Zhexembay (NU), and Jose Sanchez (UI).

The two groups presented posters on their work at the Illinois Summer Research Symposium and they gave oral presentations to members of the Mathematics Department. Several of the participants have also created interactive *Mathematica* animations for publication at the Wolfram Demonstrations website.

Karve wins People's Choice Award at Research Live! competition

Vaibhav Karve, a second year PhD student, won the People's Choice Award at the 2nd annual Research Live! competition held by the U of I Graduate College. Graduate students from across diverse schools and departments compete by giving an engaging presentation of their work and its impact in a manner suitable for a general audience in three minutes. Karve's presentation "Recognizing patterns in New York traffic ... or what happens when you apply the Netflix algorithm to taxis" won based on votes by the audience at the event. You can see his presentation at http://go.grad.illinois.edu/Watch_Research_Live/.

This research was part of the work that Karve undertook with math graduate student Derrek Yager, Professor Richard Sowers (Mathematics and IESE departments) and Professor Daniel Work (CEE department). Their work aims to provide a better understanding of traffic in big and smart cities, specifically New York, via recognizing hidden patterns in traffic data, specifically that of taxis. To achieve this they apply non-negative matrix factorization, which is the algorithm that Netflix uses to recommend movies to its users. The results, once published, could be of use to navigation giants like Google and Uber, urban developers, city planners and for disaster management.

This work was carried out with support from the department's PI4 program and the Illinois Geometry Lab.

Students compete in fall 2016 UI math contests

A combined 73 students participated in the first contest event of the academic year, the UI Freshman Math Contest, and the UI Mock Putnam Exam, held back-to-back on September 24, 2016.

The UI Freshman Math Contest is an entry level contest that provides freshmen an opportunity to show their problem solving skills in direct competition against their peers. This year's contest was won by Mark Cao, with Zhekun Zhang and Ki Wang taking Second and Third Prize, respectively. Mark is a Freshman in Mathematics, while Zhekun and Ki are Freshmen in Mathematics and Computer Science.

The UI Mock Putnam Exam is a long-running local version of the Putnam Exam, a nationwide math contest for undergraduates referred to as the "world's toughest math test."

The UI exam consists of seven challenging math problems, similar in nature to the nationanl Putnam contests, but a bit easier.

Phillip Harris, a Junior in Mathematics and Computer Science, who placed second in the 2016 Undergraduate Math Contest, won this year's Mock Putnam Exam outright. Second Prize went to Ki Wang, who improved on his third place on the Freshman Contest by one spot, while Thien Le, a Freshman in Mathematics and Computer Science, earned Third Prize.

The contests are part of the UI Math Contest Program, organized by Professors A.J. Hildebrand and Timur Oikhberg, with the assistance of graduate student Hiram Golze. For more information, visit www.math.illinois.edu/contests.html.

Student outreach

Summer math camp teaches proofs and applications

Summer Illlinois Mathematics (SIM) Camp is a mathematics day camp for high school students developed to encourage proficiency in mathematics and science by introducing students to proofs and applications of mathematics. Campers are encouraged to view mathematics as a broader and more interesting subject than just formula memorization. Showing students some of the ways mathematicians approach problems, helps to encourage them to continue studying mathematics beyond the high school level.

The department was able to run two camps this year, with 40 middle and high school students coming from the Champaign-Urbana area and surrounding counties. During the first camp, students learned how modular arithmetic and frequency analysis can be used in making and breaking codes, and learned about topological surfaces by playing games such as tic-tac-toe and Battleship on a torus and Klein bottle. During the second camp, students explored non-euclidean geometry by crafting their own tessellations of the sphere and hyperbolic disk, contemplated the meaning of mathematical proof, exploring induction and contradiction, and learned about mathematical biology by looking at SI and SIR models of diseases and using games to help visualize disease outbreaks.

SIM Camp is made possible with funding from the Office of Public Engagement, the Department of Mathematics and Illinois Geometry Lab at the University of Illinois at Urbana-Champaign, the Mathematical Association of America, and the National Science Foundation.

Mathematics graduate students Melinda Lanius, Claire Merriman, Vanessa Rivera Quiñones, and Simone Sisneros-Thiry organized SIM Camp, with help from Jennifer McNeilly and Professor Jeremy Tyson. The department is looking forward to running summer math camps again in summer 2017.

Logic focus of Sonia Math Day

In November 2016, the University of Illinois chapter of the Association for Women in Mathematics (AWM) hosted their seventh Sonia Math Day for 8th-12th grade girls. This fun filled day was packed with activities, lunch, shirts, and mathematical prizes.

The theme "Logic in Wonderland" introduced the participants to mathematical logic. In one session students pondered 'Is Alice a snake?' and learned to use propositional logic. In another session the girls took 'an infinite stroll through Wonderland' to explore cardinality and the infinite, concluding the mini-lecture with a demonstration of Cantor's diagonalization argument.

The day concluded with the Queen's tea party, where the students solved the mystery of 'Who stole the tarts?' In small groups, the girls visited booths staffed by Wonderland characters. At each stop they had to solve a logic riddle and in exchange received a clue. After visiting each station, they had enough information to complete a logic puzzle.

Sonia Math Day encourages high school girls to consider pursuing higher education in math and science and is made possible with support from the Department of Mathematics and Illinois Geometry Lab at the University of Illinois at Urbana-Champaign, and the National Science Foundation. This fall's Sonia Math Day was organized by Melinda Lanius with invaluable guidance from Michelle Delcourt, both PhD students in the department.

Alumna uses actuary science experience to fund research for cure of rare disease

Corin (Garbe) Chapman graduated from the University of Illinois in 2004 with a BS in Actuarial Science. In 2014, Chapman's 14-month-old son, Max, was diagnosed with Peroxisomal Biogenesis Disorder (PBD). PBD is a very rare disorder that causes those affected to lose their sight and hearing and eventually causes life threatening damage to kidneys, liver and bones. Most children with PBD do not live past the age of 10.

Since receiving this devastating news, Chapman has been involved with Global Fund for Peroxisomal Disorders (GFPD). She is currently on the Board of Directors of the non-profit, serving as the treasurer where she makes decisions on research funding for PBD.

Corin and Todd Chapman with their children Max and Ellie.

Her background as an actuary has allowed her to take an analytical view towards the distribution of funds among many promising research projects. Medical research funding is essentially like playing the odds. Certain projects have a much higher probability of success and lower cost, but the result may be much less impactful. The decision to aim for straight-forward research that might improve quality of life or to go for the moonshot is an exciting and heart rending risk/reward analysis.

Founded in 2010, the GFPD has funded over $140,000 in medical grants to research treatments for Peroxisomal

Disorders, as well as provide support to families facing this diagnosis through education programs, equipment exchanges, and support groups.

Chapmans says, "The research that the GFPD funds is truly cutting edge. The peroxisome of the cell is an organelle that remains a mystery to many scientists, and I firmly believe that the focused research will not only benefit our son, but will help us gain knowledge that can be leveraged for use with many other diseases and disorders."

"I think as actuaries we have a unique skill set that can be very beneficial to non-profits. Our analytical mindset, business acumen and diverse network can be extremely advantageous to many of these organizations doing amazing work. I've found the life experiences and perspective I've received working for the GFPD have benefitted both my career and life immeasurably. I encourage all individuals to step outside of their comfort zone and look into opportunities within the non-profit community," says Chapman.

In addition to her role as treasurer, Chapman and her family also chair the annual Tee It Up! for GFPD charity event in Bloomington, Illinois. Tee It Up! is a golf scramble and reception which raised almost $100,000 for the GFPD in 2016.

Chapman currently works as a life insurance actuary with State Farm. She lives in Bloomington, IL with her husband, Todd, daughter, Ellie, and son, Max.

Braunfeld shares life experience in Burns' documentary

Professor emeritus and Illinois mathematics alumnus Peter Braunfeld is featured prominently on Ken Burns' documentary "Defying the Nazis: The Sharps' War." The 75-minute film tells the story of Waitstill and Martha Sharp, a Unitarian minister and his wife from Wellesley, Massachusetts, who left their children behind in the care of their parish and boldly committed to two life threatening missions: the first in 1939 to help save Jews in Nazi-occupied Prague; the second in 1940 to help save Jews in Vichy France.

Over two years the Sharps helped save hundreds of imperiled political dissidents and Jewish refugees fleeing the Nazis. Among the people who sought help from the Sharps in Prague were Braunfeld and his parents. The film features firsthand

Peter Braunfeld

interviews with the now adult children, including Braunfeld, as well as leading historians, authors and Holocaust scholars.

Braunfeld was born in Vienna, Austria in 1930, and came to the U.S. in September 1940. The family settled in Chicago. Braunfeld's undergraduate degrees are from the University of Chicago. He received his PhD from the University of Illinois in 1959, and served on the Mathematics Department faculty until 1996.

Learn more at www.pbs.org/kenburns/defying-the-nazis-the-sharps-war/.

Alumnus gives back for students

By Dave Evensen, LAS 11/28/16

To say Robert Carr remembers clearly his first college scholarship might be the biggest understatement you'll hear today. He was a senior at Lockport (Illinois) Township High School, coming from a working class family, when he received a $250 college scholarship from the Lockport Woman's Club.

"The $250 to me (meant) somebody believed in me," Carr said, years later, "and wanted me to go to college. It meant the world to me."

Inspired, Carr came to the University of Illinois and earned a bachelor's degree in 1966 and a master's in 1967 in mathematics. In 1997, he founded a payments processing company, Heartland Payment Systems, a Fortune 1000 company that grew and thrived under his leadership. In April 2016, Global Payments bought the business for $4.3 billion.

Roughly 1,000 scholarships have been pre-funded by the Give Something Back Foundation, founded by Carr in 2003, for academically driven students of modest means who assume college is not an option. Under the Give Back program, Pell Grant-eligible students are selected in the 9th grade, mentored throughout high school, and then attend a partner university or college with the opportunity to graduate in four years with no debt for tuition and fees or room and board.

Robert Carr and students at a Give Something Back Foundation event. Give Back partners with universities and colleges in Delaware, Illinois, New Jersey, New York, and Pennsylvania. (Photo courtesy of Give Something Back Foundation.)

Carr was on campus on Nov. 29, Giving Tuesday, to present a check for $1 million to Chancellor Robert Jones to provide scholarships to fully fund 50 academically driven students of modest means at Illinois.

"The University of Illinois at Urbana-Champaign is a treasure as an elite institution of learning," Carr said. "My life was transformed there and inspired me to want to give back to other working-class kids. I am honored to extend this life-changing experience to future generations of working-class scholars via the Give Something Back Foundation."

How successful has the foundation been? 90 percent of Give Back scholars go on to earn a college degree and the employment rate is 100 percent for Give Back alumni with college degrees. Carr knows, however, that when a student didn't expect to attend college in the first place, the full impact of a scholarship can't be quantified.

"It really fueled me to succeed, graduate from college in four years, and with a high grade point average so that I could move on and break that cycle in my family of no one ever graduating from college," said Frances Brodeur, one of Give Back's first scholarship recipients, who is now a mentor and staff member for the organization. "After I got the Give Back scholarship, five family members graduated from college."

Our most recent PhD alumni:

Who they are and where they are now

- Colleen Ackermann, Visiting Assistant Professor, St. Mary's College of Maryland
- Nickolas Andersen, Assistant Adjunct Professor (3-year), UCLA
- Nerses Aramyan, Zorn Postdoctoral Fellow, Indiana University
- Brian Collier, NSF Postdoc, University of Maryland, College Park
- Meghan Galiardi, Systems Research Senior Analyst, Sandia National Labs
- Neha Gupta, Preceptor in Mathematics, Harvard University
- Jordan Hasler, Teacher, Illinois Mathematics and Science Academy
- Zhenghui Huo, Postdoctoral Teaching Fellow, Washington University, St. Louis
- Ki Yeun (Eunice) Kim, Postdoctoral position, Pennsylvania State University
- Natawat Klamsakul, Lecturer, King Mongkut's University of Technology Thonburi
- Hong Liu, Research Associate, University of Warwick
- Qu Lu, Associate in Market Risk Management & Analysis, Goldman Sachs
- Oliver Pechenik, Hill Assistant Professor, Rutgers University (1 year); Postdoctoral Assistant Professor, University of Michigan (3 years)
- Michael Santana, Assistant Professor (tenure-track), Grand Valley State University, Grand Rapids, Michigan
- Maryam Sharifzadeh, Postdoctoral position, University of Warwick
- Nuoya Wang, Data Engineer, Experian
- Jennifer Wise, Instructor, Virginia Tech
- Grace Work, Assistant Professor of Mathematics (non-tenure-track), Vanderbilt University
- Sarah Yeakel, Visiting Assistant Professor (3-year), University of Maryland, College Park

Alumni News

Mathematics alumni and current faculty and students celebrated homecoming 2016 on a warm fall day after the Illini won the football game against Minnesota.

BELLS
Jukebox!
Request a song!

Join us next fall on October 28 for Homecoming 2017!

math.illinois.edu/homecoming

Joseph Rotman, 1934-2016

Professor Emeritus Joseph Rotman passed away on Sunday, October 16, 2016, at the Meadowbrook Healthcare Center in Urbana, Illinois. He was born in Chicago on May 26, 1934, to Ely and Rose Wolf Rotman. He married Marganit Weinberger on August 25, 1978.

Rotman did his undergraduate and graduate work at the University of Chicago, where he received his PhD in mathematics in 1959. His dissertation on Abelian groups was written under the direction of Irving Kaplansky. He served on the faculty of the Department of Mathematics at the University of Illinois at Urbana-Champaign from 1959 until his retirement in 2004. He was the author of highly regarded books on a wide variety of topics, particularly in the area of graduate algebra.

While at Illinois he also held visiting positions at many other universities including Queen Mary College, University of London, 1965-66 and 1985-86; Aarhus, Denmark, summer, 1970; Hebrew University, Jerusalem, 1970; University of Padua, Italy, 1972; Technion, Haifa and Hebrew University, Jerusalem 1978-79 (Lady Davis Professor); Tel Aviv University, 1982; Bar-Ilan University, Israel, 1983; Annual Lecturer at South African Math Society, 1985; and Oxford University, 1990. Rotman was algebra editor of *Proceedings of the AMS* for the years 1970 and 1971, and he was managing editor for the years 1972 and 1973.

Rotman's work in mathematics can be divided into two parts. His research interests were in algebra, involving abelian groups, modules, homological algebra, and combinatorics. One of his early papers computed the Grothendieck group of the category of torsion-free abelian groups of finite rank; he classified countably-generated modules of finite torsion-free rank over discrete valuation rings; he determined which abstract abelian groups can be singular cohomology groups (with integral coefficients) of topological spaces; he gave a homological characterization of locally compact paracompact Hausdorff spaces; he investigated finite projective planes and found, as a byproduct, that one can regard finite graphs as quadratic forms over the field with two elements; he then used graphs to produce simple Lie algebras of characteristic 2.

The second aspect of Rotman's mathematical work involves the writing of advanced texts. Rotman's books are used at major universities worldwide, and some have been translated into Greek and Japanese. These books are: *The Theory of Groups*, with editions published in 1965, 1973, 1984, 1995; *Homological Algebra*, 1970, 1979; *Algebraic Topology*, 1988; *Galois Theory*, 1990, 1998; *Journey into Mathematics*, 1998; *Abstract Algebra*, 1996, 2000; and *Advanced Modern Algebra*, 2002, which he was revising in his final weeks.

Every serious research contribution is recorded in *Mathematical Reviews*, which keeps a record of the bibliographies. As of Dec. 6, 2016, the two editions of Rotman's book *An Introduction to Homological Algebra* have been given as a reference 684 times. Almost 50 of these, so far, are dated 2016. In addition, almost 400 books and papers have cited various editions of *An Introduction to the Theory of Groups*. Overall, Rotman's books have been referenced more than 1300 times, by almost 1500 different authors. Four students completed their PhD dissertations under Rotman's direction.

Rotman was very politically active and deeply concerned about social and humanitarian issues. He was also an Illini basketball enthusiast, and a fan of word puzzles. He loved to travel, and taught and lectured in many countries around the world.

Surviving are his wife, Marganit of Champaign; a daughter, Ella Rotman of Chicago; a son, Danny Rotman of Champaign; and a sister, Margolith Rotman of Chicago.

Memorials should be directed to Sinai Temple, 3104 West Windsor Road, Champaign, Illinois 61822-6104.

Wilson Zaring, 1926-2016

Wilson Miles Zaring passed away on Friday, July 1, 2016, at his residence in Sun City Center, Florida. Zaring was born in Finchville, KY, on November 9, 1926. He received his PhD in mathematics from the University of Kentucky in 1955 and joined the faculty of the Department of Mathematics at the University of Illinois that same year. From 1979-1991 he served as Director of Graduate Studies, retiring from the department in 1991. His Erdos number was 2.

He published seven mathematical textbooks. Zaring was the co-author, with Gaisi Takeuti, of the books *Introduction to Axiomatic Set Theory and Axiomatic Set Theory* in Springer's Graduate Texts in Mathematics series (volumes 1 and 8). In recent years, he also published seven short stories.

Zaring was trained in classical analysis with an interest in number theory. For most his career he was very focused on teacher training in mathematics.

In response to the unexpected Soviet launching of Sputnik in 1957, the Federal government initiated a massive program of reform in K-12 math education. Part of this program was the funding of curriculum development projects on a national scale. A companion part was funding professional development opportunities to prepare teachers to teach the new curricula.

For many years, Zaring was the director of an NSF-funded Academic Year Institute (AYI). This nation-wide program was an opportunity for experienced high school math teachers to come to the U of I and in one intensive year of study, obtain a Master's degree in mathematics. The AYI stipend paid participants full tuition costs, as well as housing costs for themselves and their families. He was also director of the Sequential Summer Institutes (SSI) program, which was a program that enabled college math teachers to obtain a Master's degree in math over a period of four sequential summers. Under Zaring's directorship, both these programs attracted national attention for their quality, and directly impacted several hundred teachers.

Zaring was awarded the Max Beberman Mathematics Educator Award in 1976 from the Illinois Council of Teachers of Mathematics (ICTM) and named an Outstanding Educator of America for 1974-75.

He was a member of the United Methodist Church, Sigma Xi honorary fraternity, Pi Mu Epsilon honorary fraternity, American Mathematical Society, Mathematical Association of America and International Hospitality Committee, and he was a volunteer at Carle Foundation Hospital in Urbana, IL. He served in the U.S. Marine Corps, honorably discharged at the rank of corporal on January 8, 1947.

For many of those who knew Zaring well, Hebrews 13:2 sums up his personality: "Do not forget to show hospitality to strangers, for by so doing some people have shown hospitality to angels without knowing it."

Wilson Zaring is survived by his daughter, Susan (Dennis Winter) Baker of Sun City Center; son, David (Nora) Zaring of Danvers; grandchildren, Miles Baker, Morgan Baker, Michael Zaring and Paul Zaring; and great-granddaughter, Amy Baker. He was preceded in death by his wife of 64 years, Marjorie Zaring.

Memorial contributions can be made in Mr. Zaring's name to Heifer International, 1 World Ave., Little Rock, AR 72202, or to the First United Methodist Church, 210 W. Church Steet, Champaign, IL 61820.

We count on the generosity of alumni and friends to support students as they embark on earning a world-class education and to fund faculty members as they conduct world changing research and train students. Your investment makes a difference.

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IJM participates in China consortium

The *Illinois Journal of Mathematics* (*IJM*) is partnering with Duke University and the Project Euclid to market the journal's digital content to Chinese University libraries as part of the Digital Resource Acquisition Alliance of Chinese Academic Libraries, or DRAA. Project Euclid has had a consortium relationship with DRAA (formerly known as CALIS) since 2011, with IJM signing on in 2014 with an eye to increase journal sales and accessibility.

Starting with five participating institutions in 2011, the list of participants has grown to 19 in 2016, currently increasing by 2-3 new schools per year. In addition to the *IJM*, the list of titles offered includes *Duke Mathematical Journal*, *Michigan Mathematical Journal*, *Bernoulli*, and 35 others. As part of the agreement, Project Euclid handles licensing agreements, subscription renewals, and other administrative duties with participating libraries and *IJM* receives 80% of *IJM* title sales. Revenue from DRAA sales has steadily increased each year as a result of the agreement.

We are pleased to announce the addition of a new editor, Yimin Xiao, to the Editorial Board of *IJM* earlier this year. Professor Xiao is with the Department of Statistics and Probability at Michigan State University, with research interests in stochastic processes and random fields, fractal geometry, extreme value theory, and nonparametric regression. Professor Xiao also has editorial responsibilities with *Statistics & Probability Letters, Journal of Fractal Geometry* (Managing Editor), and *Science China: Mathematics*.

Photos: Fudan University library (top) and the new library at Tsinghua University.

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