



Oregon State University
College of Science

**Department of
Mathematics**

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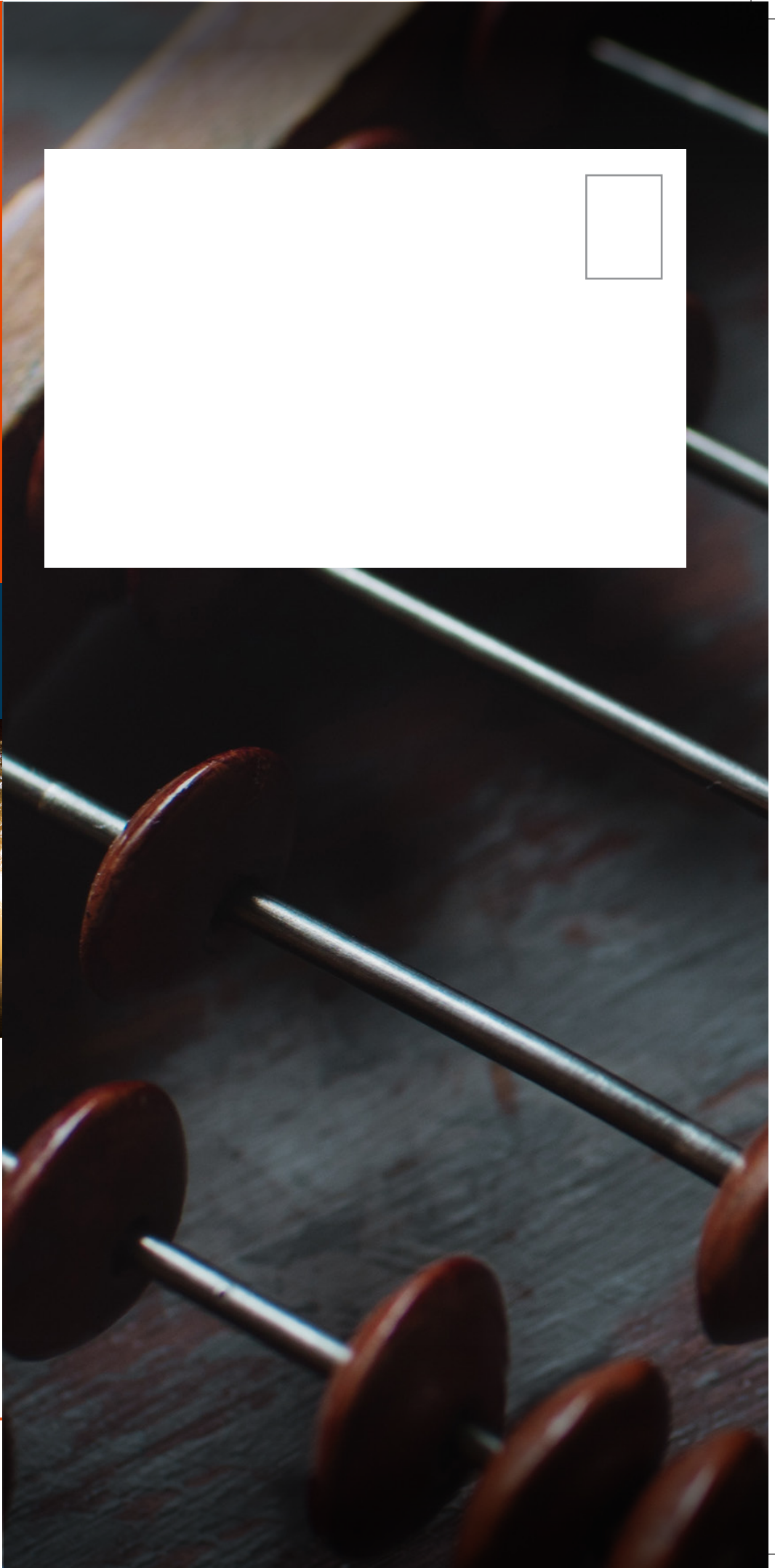
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COLLEGE OF SCIENCE DEPARTMENT OF MATHEMATICS

MATH IN THE VALLEY

Making mathematics education count

WINTER 2019



Oregon State
University

MATH IN THE VALLEY

Winter 2019

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FROM THE HEAD



Bill Bogley
Department Head

Dear alumni and friends,

Welcome back to Math in the Valley. The stories we tell impact student recruitment and public perception of mathematics. Our newsletter/website committee, chaired by Professor Vrushali Bokil, not only produces this newsletter but also animates our department website with engaging stories about the diverse activities and accomplishments of our students, faculty, and staff. So please drop in on the website for the latest research seminar announcements, award and grant news and updates on student internships, faculty travel, and community events.

It has been a banner year for our graduate program, with 14 new Ph.D.s and 15 M.S. degree recipients. The Graduate Committee, chaired by Professor Malgorzata Peszynska, has recruited a strong new cohort of 17 incoming graduate students for Fall 2019. Last April, the inaugural Graduate Appreciation and Research Showcase featured an energetic poster session and lightning oral presentations

along with delicious refreshments and prizes (see p. 12).

In the following pages, you'll read about faculty research accomplishments in mathematics education, number theory, dynamical systems and more. Research in the department continues to span applied and theoretical advances and increasingly involves undergraduates. Over half of our tenure-stream faculty members are working on externally funded research with project budgets totaling just under \$5 million.

Undergraduate student success is core to our departmental mission. We are working to sustain and extend the achievements of our instructors (also called Team Math) in College Algebra (reported in last year's newsletter!) throughout the lower division curriculum as well as online where more and more of our students are choosing to enroll. We'll introduce you to our new Mathematics and Statistics Learning Center Coordinator Wendy Aaron (p. 2), who is leading a community

of practice to foster quality in online instruction, among other initiatives. At this year's Lonseth Lecture (see p. 17), Dan Rockwell and Professor Bob Higdon won inaugural student-selected awards for undergraduate instruction. Congratulations to both of them!

Our graduate students lead energetic outreach efforts to connect community members with mathematics (see p. 16). We are taking proactive steps to ensure that our community of mathematicians is welcoming and inclusive for all, including women and LGBTQ community members (p. 16-17).

Last, I am happy to report that we are expanding our faculty! A national search for three new full-time instructors closed in September 2019 and this fall we launch a tenure-track assistant professor search, our first in several years. We appreciate your support as we work to sustain a vibrant future for mathematics at OSU.

With best wishes to all,

Bill Bogley



AT THE HELM

Advancing mathematics through leadership



Wendy Rose Aaron

Wendy Aaron is helping students succeed in mathematics

The department welcomed **Wendy Rose Aaron** as the new coordinator of the Mathematics and Statistics Learning Center (MSLC) this year. Aaron received her Ph.D. in mathematics education from the University of Michigan in 2011 and joins us most recently from the faculty of the College of Education at Oregon State University. She brings extensive expertise and experience in teacher-training, including contacts with local K-12 schools.

As MSLC Coordinator, Aaron will build upon strengths of the MSLC to help students succeed in mathematics. She will promote a welcoming and inclusive environment, oversee daily operations and provide professional development to graduate students and learning assistants in their work with undergraduates. Aaron also serves as department liaison to other student success initiatives across campus.

Tenure & promotions

Congratulations to four mathematics faculty on their successful promotions in 2018-19. Drs. **Sara Clark**, **Ryan Hass** and **Elizabeth Jones** were promoted to Senior Instructor I. Hass has taken a lecturer position at the University of California, Berkeley. Assistant Professor **David Koslicki** was promoted to Associate Professor and granted indefinite tenure; he has since taken a new position at Pennsylvania State University.



Juan Restrepo

Excellence in research, service & teaching

Honor for advancing the mathematics of climate change

Juan Restrepo has been elected a Fellow of the American Physical Society (APS). The APS Council of Representatives made this decision upon the recommendation of the APS Topical Group on Physics of Climate. This award recognizes researchers who have made outstanding contributions to physics through research, teaching or service. Restrepo was awarded the fellowship "For advancing the understanding of wave dynamics and uncertainty quantification in the climate system." Throughout his career, Restrepo has made several impressive contributions to the mathematical and computational modeling of the ocean and atmosphere.

Restrepo was also elected president for a three-year term of the Nonlinear Geophysics Section of the American Geophysical Union and will serve as

president elect in 2019, president in 2020, and then as past president in 2021. He will have a portfolio that includes climate change, big data initiatives, linking social sciences to climate science and diversity initiatives among others.

Fulbright award takes mathematician to Norway

Elise Lockwood has been awarded a 2019 Fulbright research scholarship. Lockwood's award took her to the University of Oslo in Norway where she is investigating the role that computing can play in students' learning of mathematical concepts. (See the cover story on Lockwood). She also received the Dean's College of Science 2018 Early Career Impact Award. This award recognizes exceptional achievement in research and education by early career, tenure-track faculty in the College of Science. In addition, Lockwood has been awarded the OSU 2019 Promising Scholar award which recognizes the scholarship of junior faculty.

Malgo Peszynska appointed to nation's top research agency

The National Science Foundation has selected **Malgo Peszynska** to serve as rotating program director within its Division of Mathematical Sciences (DMS) in Washington, D.C., effective September 2019 for a period of up to two years. She will review national research proposals and make crucial funding recommendations during her term. The unique opportunity will enable Peszynska to help shape the future of the field of mathematics research and education. Specifically, she will work within the DMS Computational Mathematics program, which supports mathematical research in areas of science where computation plays a central and essential role.



Malgo Peszynska

Supporting future mathematicians at OSU's 2019 Undergraduate Student Success Summit

The Student Success Summit brought together administrators, faculty, graduate students and undergraduate students to discuss ways to enhance the student experience and outcomes at OSU. Instructors **Sara Clark, Katie Williams, Elizabeth Jones, Dan Rockwell, Lynn Riverstone**, MSLC coordinator **Wendy Aaron**, Professor **Vrushali Bokil** and graduate student **Naveen Somasunderam** all presented at the summit. Clark, Jones, Riverstone, Rockwell, and Williams presented a poster highlighting the benefits to students and faculty of the online grading tool Gradescope.

"What I really enjoyed about the event was the fact that it brought everyone together. There aren't many instances in which instructional faculty, administrators and support staff all get to be in the same room and discuss strategies for student success. That was really exciting, and I hope there will be more of this in the future!" said Williams.

Clark, Riverstone and Williams presented a talk on "Fostering Community in College Algebra." The

instructors, along with a panel of students, discussed how the students in College Algebra classrooms make lasting friendships, build mathematical confidence and become more self-reliant in their learning.

Several members of the mathematics department also gave lightning talks at the summit. Aaron gave a presentation about the student support provided in the MSLC. Somasunderam, along with Bokil, provided an overview of the directed reading program network, which pairs undergraduate students and graduate student mentors to explore interesting mathematical readings. Finally, Rockwell presented a talk, along with Susan Fein of Ecampus, about digital photo hunts in online College Algebra.

Faculty awards presented at 2019 Lonseth Lecture

Several faculty received awards during the 34th annual Lonseth Lecture held on April 19, 2019. **Elaine Cozzi** was recognized by graduate students with the 2019 Graduate Faculty Award, in recognition of her impact through teaching and research, while **Vrushali Bokil** and **Nathan Gibson** jointly received the 2019 Joel Davis Faculty Award. Two new faculty awards were presented for the first time in 2019: The Mathematics Student Success Award, which went to **Dan Rockwell**, who was nominated and selected by undergraduates to recognize inspirational teaching in a lower division mathematics course. The inaugural Mathematics Majors Award for Teaching went to **Bob Higdon**, who was nominated and selected by undergraduates. The award recognizes inspirational teaching in upper division mathematics courses. Read more about our 2019 Lonseth Lecture on page 17.



Tom Schmidt with his former doctoral student, Katthaleeya Daowsud ('13) during a conference trip to Thailand.

Enhancing national and global leadership in mathematics

Mathematics faculty continually organize and participate in regional, national and international conferences. Captured below are a few recent highlights.

Geometry in Seattle

Christine Escher co-organized the Pacific Northwest Geometry Seminar at the University of Washington, Seattle in April 2019. In July 2018, Escher also participated in a three-week summer research visit for Women in Mathematics at the Mathematical Sciences Research Institute in Berkeley, California.

Oregon Number Theory Days

Holly Swisher and **Clay Petsche** co-organized the Oregon Number Theory Days in February 2019 at OSU, which included two talks by plenary

speaker John Voight, a mathematician at Dartmouth College, and two talks by postdoctoral scholar Piper H at the University of Hawaii at Manoa. One of Piper's talks described personal stories about working through adverse experiences in mathematics.

Calculus in Baltimore

Tom Dick organized a special calculus conference for advanced placement calculus teachers held during the Teachers Teaching with Technology International Conference in Baltimore, Maryland, in March 2019.

Teaching Lorentzian geometry and general relativity in West Africa

Tevian Dray spent three weeks in West Africa as part of the Visiting Lecturer Program of the International Mathematical Union. Dray was invited to teach a graduate course in Lorentzian Geometry and General Relativity at the Institut de Mathématiques et de Sciences Physiques (IMSP) of the Université de Abomey-Calavi in the Republic of Benin.

The IMSP is an African Centre of Excellence in the Mathematical Sciences, sponsored by the World Bank, with additional support from the Abdus Salam International Centre for Theoretical Physics, and attracts students from across West Africa. Professor Dray's course was attended by students from Burundi, Cameroon, Congo, Guinée, Mauritania and Togo, in addition to Benin. While at the IMSP, Professor Dray also gave a colloquium entitled "Using Active Engagement to Teach Mathematics."

Dray has extensive international experience, including several previous stays in India, although this was his first visit to West Africa.

Going international with number theory

The last several years have seen **Tom Schmidt** traveling internationally to interact with co-authors and to speak at conferences. 2018 was no different.

Last year, Schmidt spoke at a workshop held on the island of Porquerolles, and at a seminar in Marseille, both in France, and he was an invited speaker to a conference that December in Pisa, Italy. There he and Giulio Tiozzo began discussions about exploring generalizations of Tiozzo's stunning Ph.D. work showing connections between the geometry of certain families of continued fractions and dynamics related to the Mandelbrot set.

In January 2019, Schmidt participated in a special session of the Joint Mathematics Meeting, where he reported on his joint work with K. Calta and C. Kraikamp focused on an infinite collection of families of continued fractions. He also attended the July 2019 workshop on number theory and dynamics held at Dongguk University's "Manhae Village" in South Korea. At this workshop, Schmidt reported on geometric techniques for studying families of continued fractions, which is his joint work with Kraikamp.

Research funding surges

Fifteen faculty members were awarded external funds totaling \$4.8M. Here are some highlights.

Tevian Dray is a co-PI on two Paradigms in Physics projects which have been awarded National Science Foundation (NSF) funding. One NSF grant, in the amount of \$299,282, is for "Representations in Quantum Mechanics," in which Dray, along with

Principal Investigator (PI) Elizabeth Gire, and co-PIs Corinne Manogue and David Roundy, will develop a student learning progression for concepts in quantum mechanics. A second NSF grant, in the amount of \$298,948, was awarded to Dray for the project, “Second-Generation Dissemination Strategies,” along with physicists David Roundy, Elizabeth Gire, and Corinne Manogue. This grant will provide funding to redesign current project websites and online books to be more user-friendly.

Malgo Peszyska is PI of the NSF-funded project “Modeling with Constraints and Phase Transitions in Porous Media” with a total budget of \$224,402 for 2019-22. The project will address mathematical and computational challenges arising in the models of phase change in porous media such as permafrost, sub-sea sediments, geysers or geothermal reservoirs, and the evolution and migration of the fluids as the phase change occurs in response to an increased temperature or mechanical disturbance.

Elise Lockwood was awarded a travel partnership grant (funded in Norway) with Morten Hjorth Jensen from the University of Oslo as the

PI. This travel partnership grant is for travel between the University of Oslo, Michigan State University, and Oregon State University with a budget of \$4.5M Norwegian Kroner (~\$529,000 USD) over the years 2019–22.

Vrushali Bokil was awarded the Thomas Jefferson Fund (\$21,620) from the Face Foundation for Transatlantic research over the years 2018-20. Bokil will work with co-PI Associate Professor Frederic Hamelin at the University of Rennes in France on the project titled, “Mathematical Epidemiology of Viruses Coinfecting Plants: Modeling, Analysis and Optimal Control Strategies.” Mathematics graduate student Brady Bowen is involved in this research and will be funded from this grant to travel to Rennes.

Remembering David Carter

Emeritus Mathematics Professor **David Southard Carter** passed away on December 28, 2018. Professor Carter received his Ph.D. in mathematical physics from Princeton University in 1952. His contemporaries in Princeton included Albert Einstein, John Wheeler and John Von Neuman.

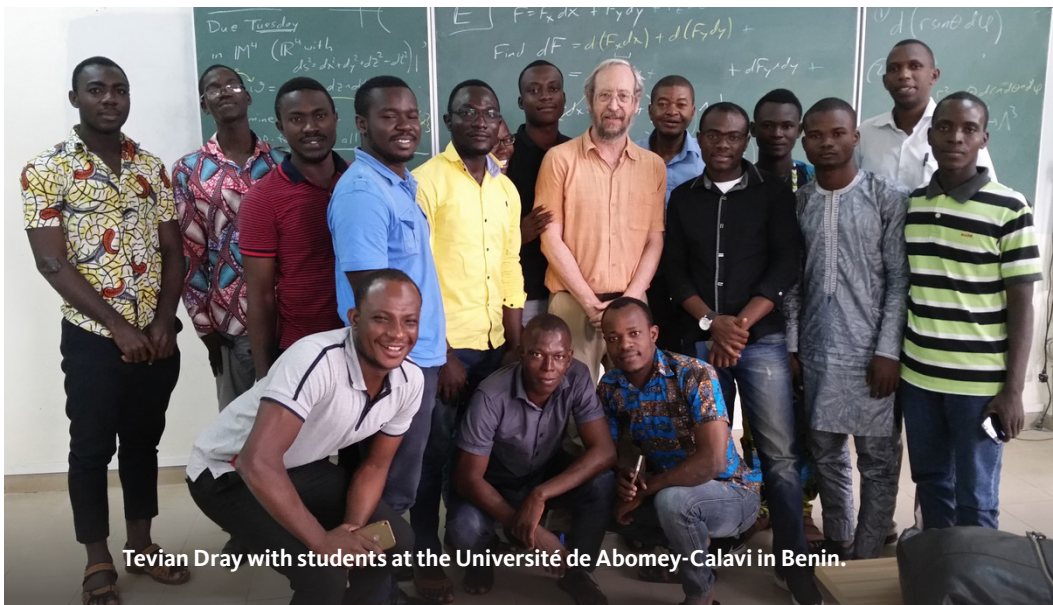


Elaine Cozzi (left) received the 2019 Graduate Faculty Award.

While at Princeton, Carter was a member of Project Matterhorn, which focused on the mathematics of thermonuclear weapons. As part of that work, he programmed the ENIAC which was the first general purpose computer.

From 1952 to 1957, he was at the Los Alamos National Laboratory working on nuclear fusion reactor research. He joined the OSU mathematics department in 1961 and retired in 1991. Carter graduated 6 Ph.D. students and two M.S. students in mathematics. One of his Ph.D. students was Stephen Scarborough, who, in turn, retired from OSU as senior instructor in 2016.

Professor Carter was predeceased in 2012 by his wife of 62 years, Ruth. He is survived by their four children and eight grandchildren.



Tevian Dray with students at the Université de Abomey-Calavi in Benin.

THINKERS & DOERS

Math graduate finds inspiration from women mathematicians at OSU

Mathematics student **Sara Tro** ('19), who holds minors in actuarial science and Spanish, completed her Honors thesis, in which she analyzed Maxwell's equations with the Duffing model in nonlinear optics, under the guidance of mathematics professor Vrushali Bokil. Sara says that doing research for her Honors thesis was one of the highlights of her undergraduate career.

Sara was inspired by the number of women mathematics professors she met at OSU, who make up 30%, compared to 16% nationally, of the graduate faculty in the mathematics department. "In my very first term, I had a vector calculus class with Dr. Elaine Cozzi. After taking a number of classes, I started to realize that all my favorite math professors were women. It helps to see other women in front of the room," said Sara.

In 2017, an Honors Experience Scholarship led her to participate in the OSU in Cuba program for two weeks in 2017. The granddaughter of Cuban immigrants, Sara had always wanted to visit Cuba.

A "straight-A" student, Sara has garnered several awards for her academic achievements, including the mathematics department's Edward Stockwell Award and the WIC (Writing Intensive Curriculum) Culture of Writing Award. She is currently a Ph.D. student in the top-ranked Department of Applied Mathematics at the University of Colorado, Boulder.

Using data to increase efficiency of public and private sectors

Rachel Legard ('19), who graduated with degrees in mathematics and business, is working as an analyst as part of Deloitte's Human Capital Team in Portland, Oregon. With an acceptance rate of only slightly above 4% by the company, this is a stellar achievement in many ways. At Deloitte, Rachel will be able to combine the skills she learned in both of her majors to improve the efficiency of governments and private sector businesses, while traveling on-site around the country.

"It was fun to see that they were really interested in mathematics majors. Even though I'm not going to be doing derivatives every day, I'm still going to use the problem-solving techniques I learned in my major," said Rachel, a daughter of OSU alumni. Starting out as a mathematics major with an option in statistics, Rachel realized early on that what truly drew her to the field was, "seeing data turned into something useful and meaningful."

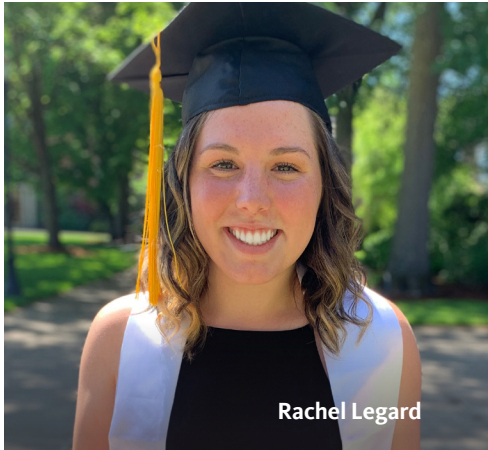
A RARE gem in actuarial mathematics

Alumna **Corina Constantinescu** (Ph.D. '06) was promoted to professor of mathematics in the Department of Mathematical Sciences of the University of Liverpool in the United Kingdom in 2019. Since 2015, Constantinescu has led the Institute for Financial and Actuarial Mathematics (IFAM) as its director.

Constantinescu completed her Ph.D. thesis in the area of actuarial mathematics at OSU in 2006 under



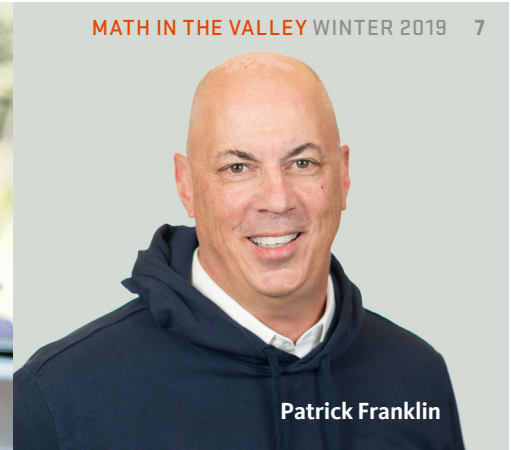
Sara Tro



Rachel Legard



Corina Constantinescu



Patrick Franklin

the supervision of Enrique Thomann. Her research is still in actuarial mathematics, more specifically in risk theory and risk management, and her teaching record spans various areas of financial and actuarial mathematics. She is interested in correctly pricing car insurance in European countries in which the gender considerations have been recently removed from the underwriting process.

Constantinescu has coordinated a large European grant under the Marie Curie framework, on Risk Analysis, Ruin and Extremes (RARE), that connected 12 higher education institutions and over 60 researchers from all over the world working on extreme events and their applications to insurance modeling.

Prior to being an academic, Constantinescu worked as an actuary and led the life insurance department of one of the first private Romanian insurance companies.

Mathematics graduate program surpasses 1,000 degrees

Not only did 2018-2019 see an all-time record number of graduate degrees with 14 Ph.D.s and 17 master's — exceeding the previous high numbers in each of 2017, 2015, 2012 and 2011 — but our graduate program has now conferred its 1,000th graduate degree since its first in 1933. The latter went to **Holly Clair Fryer** who was advised

by W. E. Milne. Specifically, OSU Mathematics has awarded a grand total of 1,007 masters and Ph.D. degrees as of June 2019. The number of 22 graduates in the preceding nine months is more than the department had in its first 16 years combined!

Spearheading large-scale transformation

If, as they say, a four-year college degree should prepare students for the next 40 years of working life, and for a future that none of us can imagine, then **Patrick Franklin's** ('88) undergraduate mathematics degree has paid off handsomely. Franklin's OSU mathematics education gave him several foundational capacities that have helped him not only adapt but also thrive in some of the most competitive and iconic work places in America: Intel, Microsoft, Amazon, Google and General Electric.

Currently, Franklin is executive vice president and chief technology officer at American Express Company, the behemoth New York-based financial services corporation. When Amazon was still a young company, Franklin came on board to lead its retail systems and spearheaded large-scale transformations. "The system transformation (at Amazon) was not as much of a software exercise as it was a puzzle or logic or design problem. That's what mathematics teaches you. I don't think you can get that in other disciplines," said Franklin.

As a member of the Board of Advisors for the College of Science, Franklin cherishes the opportunity to deepen his ties to his alma mater.

GRADUATES SNAG JOBS IN ACADEMIA AND INDUSTRY

Congratulations 2018–19 Ph.D.s!

Azhar Alhammali, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia
Allison Arnold-Roksandich, Boise State University, Idaho
Charles Camacho, University of Washington, Seattle
Zheting Dong
Claire Gibbons, Pierce College, Puyallup, Washington
Eleanor (Dwight) Holland, Oregon State University
Huanqun Jiang, Michigan State University, East Lansing
Stephen Krughoff, Oregon State University
Jason McClelland, College of Idaho, Caldwell
Zackery Reed, Oklahoma State University, Stillwater
Michael Renne, Rutgers University, New Jersey
Naveen Somasunderam, State University of New York, Plattsburgh
Samantha Smith, Green River College, Auburn, Washington
Joseph Umhoefer, Vice President at Solid Modeling Solutions, Bellevue, Washington

ELISE LOCKWOOD IS COUNTING HER WAY TO SUCCESS

BY TOM DICK



Elise Lockwood became fascinated with combinatorics and counting problems as a graduate student and has devoted her academic career to understanding how students reason about such problems. Enumerative combinatorics is the mathematics of counting — calculating how many objects meet some stated conditions.

Even though “counting” sounds basic, such problems can be easy to state but surprisingly difficult for students at all levels to solve. In her thesis at Portland State University in 2011, Lockwood developed a model of students’ combinatorial thinking that is still a foundational part of her research today.

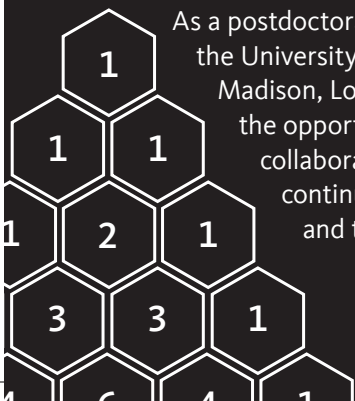
from her dissertation. These include examining student reasoning about the multiplication principle (a fundamental principle in combinatorics), studying the role of listing outcomes in students’ combinatorial activity, making the case for the importance of focusing on sets of outcomes in counting, and developing alternative modes of instruction that might help students understand basic combinatorial concepts and formulas.

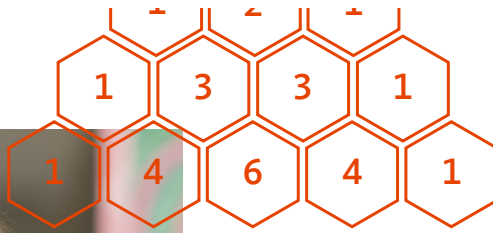
undergraduate mathematics education (called RUME). She has often employed a “teaching experiment” methodology, interviewing students for multiple hours over the course of a term, allowing her to gain insight into how students think and learn about mathematical concepts.

Lockwood’s work focuses on undergraduate students and is part of a growing field of research in

Lockwood has collaborated with colleagues from across the country, including researchers at Portland State University, Rutgers University, the University of Cincinnati, Ithaca College, and Columbia University. Her collaboration with researchers

As a postdoctoral researcher at the University of Wisconsin-Madison, Lockwood enjoyed the opportunity to establish collaborations that continue to this day and to develop ideas





undergraduate mathematics and computer science students.

Lockwood has recently begun an international collaboration with researchers at the University of Oslo in Norway, who also have interests in computation as a part of mathematics education. Lockwood was awarded a U.S. Fulbright Scholar Grant to conduct research in Oslo from August to December 2019, where she will collect data on the Norwegian students' experiences in their computational courses. The Fulbright Program supports activities and projects that recognize and promote educational exchange and international understanding. A key objective for Lockwood, who is a project member of the International Partnership for Computing in Science Education, is to determine how to improve the teaching and learning of mathematics by incorporating computing into mathematics classes.

Lockwood received the Dean's Early Career Impact Award in Fall 2018, recognizing exceptional achievement in research and education by an early-career faculty member in the College of Science. With colleagues Jennifer Parham-Mocello in the College of Engineering and Rebekah Elliott in the College of Education, Lockwood has been awarded a Google Grant to work with pre-service teachers and incorporate computing into pre-service teacher courses.

Lockwood regularly writes with her students. She has published journal articles and conference papers with current graduate students and continues to collaborate with her former students. Lockwood loves to instill a passion for research in her students and hopes she can model ways to be an effective researcher to the next generation of mathematics education students.



Mary Beisiegel

from the University of Georgia and Indiana University resulted in a NSF-funded grant entitled Generalization Across Multiple Mathematical Areas (GAMMA). This three-year \$1.5M research project studied the nature of generalization across age ranges and mathematical domains.

In 2017, Lockwood was awarded a National Science Foundation Early CAREER Award entitled "Developing Undergraduate Combinatorial Curriculum in Computational Settings" that grants her \$800K over five years. Motivated by the increasingly prevalent role that computing plays in STEM fields, she seeks to find meaningful ways to integrate computing into students' mathematical experiences. She believes that certain aspects of computing can help students learn mathematical concepts, and she aims to leverage computational settings, specifically, introductory Python programming, to strengthen aspects of students' combinatorial reasoning. In the first two years of the project she and her team of graduate research assistants have interviewed pairs and small groups of students and tested initial versions of activities among

A LEGACY THAT LASTS

The OSU mathematics department faculty has long included scholars with research expertise in mathematics education. Elise Lockwood became a faculty member in 2013, joining fellow mathematics education researchers **Mary Beisiegel** and **Tom Dick**.

Beisiegel, an associate professor, has studied mathematics teacher development at all levels, from K-12 to graduate students and university mathematics instructors. She has worked with the National Center for Teacher Effectiveness (NCTE) housed in the Harvard University Graduate School. She has studied elementary school instruction using an observation tool called Mathematical Quality of Instruction (MQI). With researchers from Harvard, Beisiegel was awarded a National Science Foundation grant to study the adaptation of the MQI to a professional development tool for teachers, and more recently she was awarded a NSF grant to undertake a longitudinal study of the development of graduate students as teachers.

Starting in fall 2019, Beisiegel has taken on the role of director of foundational mathematics, providing professional support for the department's teaching mission in freshman and sophomore-level mathematics courses.

Through the years, mathematics faculty have helped to establish a national and international reputation for scholarly work in mathematics education at OSU: Gary Musser, Mike Shaughnessy, William Burger, Howard Wilson, Blake Peterson, and Barbara Edwards. Two other current faculty members with interests in mathematics education include Tom Dick, whose research area has focused on uses of mathematics technologies in teaching; and Tevian Dray, who has done significant work in redesigning curricula for vector calculus and physics.

DELIVERING IMPACT

Students make their mark
in mathematics

Fairy circles located in the Namib desert, in the Namib-Naukluft National Park of Namibia. Rachel Sousa studied fairy circles for her SURE Science scholarship.

Mathematics and physics student named Goldwater Scholar

Ryan Tollefsen, an Honors double major in physics and mathematics, was awarded the prestigious 2019 Barry Goldwater Scholarship, which is the top undergraduate award in the country for sophomores and juniors in the fields of science, technology, engineering and mathematics. Goldwater Scholars are selected on the basis of outstanding academic achievement and for demonstrating the potential to pursue research careers.

Ryan has received a number of awards for academic excellence and achievement. These include the Nicodemus Scholarship in Physics, the College of Science's Harriet Anderson Scholarship and OSU's Finley Academic Excellence Scholarship.



Eli Nicholas

Seeing the math in music

Second-year mathematics major **Eli Nicholas** was awarded OSU's most competitive, merit-based scholarship for in-state undergraduates: The OSU Presidential Scholarship. This award is given to the highest-caliber high school seniors in Oregon with a record of academic excellence among other accomplishments.

A mathematics major, Eli is combining his love for numbers with his passion for music by pursuing a minor in music performance. At OSU, Eli is exploring diverse interests including vocal performance. This year, he achieved a milestone by singing for the first time at an OSU opera, Puccini's "La Rondine."



Barton Gattis

Graduate students win national and OSU awards for research

Barton Gattis received the 2019 OSU-Pacific Northwest National Laboratory (PNNL) Distinguished Graduate Research Program fellowship. The four-year program includes full financial support. The unique program allows the student to complete coursework at OSU and subsequently transfer to PNNL where the research component of the degree program will be carried out. As part of his dissertation research, he will work on a collaborative project "Automated Risk Adjustments via Data-Driven Dynamics and Artificial Intelligence," mentored by both Professor Juan Restrepo and PNNL scientist Robert Brigantic.

Ruby Chick has been awarded a fellowship by the NSF Research Traineeship program in "Risk and Uncertainty Quantification in Marine

Science" program at OSU. Ruby will be participating in the project, "A Systems-based Understanding of Microplastic Impacts on Ecological and Human Health."

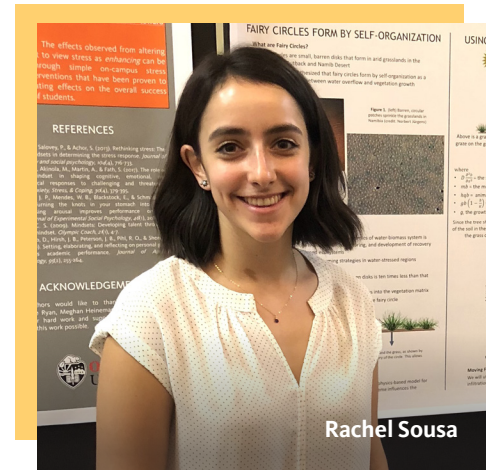
Choah Shin is the 2019-20 recipient of the Larry W. Martin and Joyce B. O'Neill Endowed Fellowship. Choah's nomination emphasized her use of computations for modeling how fluids flow and change phase in the subsurface sediments.

Preparing for future careers through summer research

Last summer mathematics major **Rachel Sousa** received a SURE Science scholarship to conduct summer research at OSU to elucidate the physics underpinning an ecological phenomenon known as "fairy circles" in arid grasslands using mathematical modeling, computer simulations, and programming. In summer 2019, Sousa conducted research at the University of Utah for 10 weeks through the National Cancer Institute Systems Biology and Physical Sciences Summer Research Program working with Fred Adler on "Mathematical modeling of tumor evolution and cancer-immune cell interactions to understand and improve patient response to therapy."

Lisa Bigler participated in a summer school on computational cardiac physiology during summer 2018 in Oslo, Norway funded by Simula Research Laboratory. The first half of the summer school was in Oslo, and the second half was held at University of California at San Diego.

Three mathematics graduate students were selected to attend summer programs this year that are organized and funded by the Mathematical



Sciences Research Institute (MSRI). **Daniel Erickson** attended the school on "Recent topics on well-posedness and stability of incompressible fluid and related topics" at MSRI in Berkeley. **Choah Shin** attended "Mathematics of Machine Learning" at Microsoft, Seattle, and **Worapan Homsomboon** attended "Geometric Group Theory" in Oaxaca, Mexico.

Naren Vohra and **Ruby Chick** participated in the Graduate Student Mathematical Modeling Camp held at the University of Delaware in June 2019. Vohra went on to also attend the corresponding Mathematical Problems in Industry Workshop held at the New Jersey Institute of Technology in Newark.

Think BIG!

Jobs in Business (**B**), Industry (**I**) and Government (**G**), are consistently rated among the highest areas for job satisfaction. During summer 2019, mathematics students had an exciting and fruitful time, gaining research experiences in internships at national labs.

Mathematics senior **Michael Kupperman** was funded by the US Department of Energy (DOE) at Los Alamos National Laboratory (LANL) through the Science Undergraduate Research Internship Program hosted by the DOE Office of Science.



Michael was selected for a 10-week internship to work on developing and expanding technical capabilities to aid in analyzing dynamics of viral diseases, utilizing machine learning techniques to better understand complex patterns in viral evolutionary dynamics.

Evan Rajbhandari was awarded an Oak Ridge Institute for Science and Education (ORISE) Graduate Internship to perform research at the National Energy Technology Laboratories site in Albany, Oregon, for 15 weeks. His work consisted of computational simulations of a closed-cycle magneto-hydrodynamic power generator.

Lisa Bigler participated in an internship in the Applied Numerical Algorithms group at Lawrence Berkeley National Laboratory (LBNL) studying numerical modeling in the Computational Research Division with funding by LBNL.

Sebastián Naranjo Álvarez returned to LANL again to continue working on problems in computational magneto-hydro-dynamics in the Applied Mathematics and Plasma Physics Groups of the theoretical division. Funding was provided by an INTERN workforce supplemental award to his major professor, Vrushali Bokil as part of her NSF grant.

Choah Shin, a fourth year mathematics graduate student was

selected for the NSF Mathematical Sciences Graduate Internship. Shin worked on a project that is focused on computational fluid dynamics solutions of supercritical fluids for energy technologies. The project was carried out at the National Renewable Energy Laboratory in Denver. Shin presented her research at the Rocky Mountain Fluids Conference in August.

Welcoming our largest graduate cohort

The department welcomed a new graduate cohort in 2018-19 that is the largest ever, with 23 students entering their first year of regular study at Oregon State, one exchange student from France, and another who is getting a concurrent degree in engineering. The department also has three students beginning their Accelerated Masters Platform-ramp year. Two from our cohort have received recruitment awards: **Hannah Barta** is a Provost Scholar, and **Nachuan Zhang** is a recipient of the Wei Family Foundation Scholarship.

The department held a Graduate Appreciation and Research Showcase in April 2019 during Graduate Appreciation week. The program consisted of professional development sessions presented by the participating faculty, and oral blitz mini-lectures and poster presentations by graduate students. The winners of

the awards at the Graduate Research Showcase were **Stephen Krughoff** for best blitz presentation, and **Dallas Foster** and **Branwen Purdy** who tied for best poster.

Amassing awards for leadership in innovative teaching, outreach and research

Ph.D. students **Sarah Hagen** and **Naveen Somasunderam** recently received top mathematics department awards. Somasunderam received the Graduate Student Excellence Award, and Hagen received the William F. Burger Graduate Teaching Award.

Somasunderam just finished his Ph.D. dissertation research in number theory and is a tenure track assistant professor at the State University of New York at Plattsburgh. Hagen's ongoing Ph.D. dissertation research is in partial differential equations. Both have also shown enormous individual leadership in adapting active learning methods to their teaching, as well as initiating mathematics outreach activities.

Hagen designed both a week-long boot camp for incoming graduate students as well as a Ph.D. qualifying exam preparatory course. Somasunderam created an active learning classroom in teaching calculus, and co-created the Mathematics Circus Project aiming



to bring out the artistic and aesthetic aspects of mathematics, by enabling children to play with 3-D printed mathematical objects.

Disseminating research

Several mathematics graduate students attended two of the largest mathematics conferences; the Annual Meeting of the Society for Industrial and Applied Mathematics (SIAM) and the Joint Mathematics Meeting (JMM), which is described as “the largest mathematics meeting in the world.”

The SIAM Annual Meeting of summer 2018 was held in Portland, Oregon. As one of only two student chapters in the state, the OSU SIAM student chapter was called upon to help out with local arrangements and welcoming of students from around the world. Our chapter helped create the Local Portland Attractions Student Social Events Guide, and several of our students volunteered at the registration desk.

Our graduate students who presented posters or talks included **Joe Umhoefer, Diana Gonzalez, Will Mayfield, Choah Shin, Azhar Alhammali,** and **Sandeep Koranne.**

Choah and Azhar additionally participated in the Professional Development Evening, where students learned an “inside-out approach.” In addition to an invited talk in a mini-symposium, Umhoefer presented a poster as the OSU SIAM student chapter representative. During this poster session he met a researcher at the Army Research Lab at Aberdeen Proving Grounds, Maryland, who invited him to give a seminar there in. Thanks to connections he made at the SIAM Career Fair, Umhoefer landed a part-time telecommuting internship at Solid Modeling Solutions, Inc., in Bellevue, Washington. He is now a full-time employee there.

This year, JMM was held in Baltimore. Seven graduate students attended and presented talks or posters: **Charles Camacho, Michael Renne, Claire Gibbons, Naveen Somasunderam, Sarah Hagen, Allison Arnold-Roksandich,** and **Zheting Dong.** Travel funding was provided by the American Mathematical Society Travel Grant and the Graduate School Travel Award.

There were other noteworthy conference presentations that we highlight below.



Sarah Hagen and Naveen Somasunderam

Zheting Dong received funding and presented a talk at the Australian-German Workshop on “Differential Geometry in the Large,” in Melbourne, Australia in February 2019.

Azhar Alhammali, Lisa Bigler, Choah Shin and **Joe Umhoefer** presented at the 2019 SIAM Conference on Mathematical & Computational Issues in the Geosciences held in Houston in March 2019. SIAM Travel awards, the Department of Mathematics and NSF provided support for travel.

Five graduate students participated in a workshop of the NSF-funded program “Transforming Instruction in Undergraduate Mathematics via Primary Historical Sources,” co-organized by **David Pongelley** and held on July 19-20 at New Mexico State University. The program creates student projects for use in the undergraduate mathematics classroom which teaches content based around primary historical sources. The participants were **Adaline De Chenne, Sarah Erickson, Sarah Hagen, Branwen Purdy,** and **Naveen Somasunderam.** Hagen made a one-hour featured presentation at the workshop.



Choah Shin and Azhar Alhammali



OSU scholarships support students' mathematical projects

The Office of Undergraduate Education through its URSA Engage program has funded seven undergraduate students to work with three mathematics faculty on their mathematical research projects. Designed to establish mentoring relationships for undergraduates early in their academic programs at OSU, URSA Engage aims to provide first and second year students, or transfer students in their first year at OSU, opportunities to pursue research under the guidance of an OSU faculty member of any rank. The program is available to undergraduates and mentors at all

OSU campuses and across all academic disciplines. Interdisciplinary projects and teams are particularly encouraged. Undergraduate research often plays a key role in developing student-faculty relationships, and gives students hands-on learning experiences that help them grasp the practical applications of science beyond the scope of the classroom.

Mathematics faculty awarded 2019 URSA grants include **Malgo Peszynska**, **Blessing Emerenini** and **Hoewoon Kim**.

The projects supervised by Kim involved solving the linearized incompressible

Navier-Stokes equations. The first component of the work was developing a mathematical and physical understanding of the motion of incompressible fluids (e.g., water) in the interior and exterior of a sphere through basic differential equations such as the diffusion equation and the Laplace equation. Secondly, students investigated the stability problem which deals with the following interesting question: "Under what conditions can we show that a mathematical object which satisfies a certain property approximately must be close to another object which satisfies the property exactly?"

Alan Schultz and **Cooper Nicolaysen**, a sophomore physics and mathematics double major, both worked on these projects.

The projects proposed by Emerenini were related to the mathematical modeling of super-spreading of infectious diseases, specifically to disease transmissions, persistence and extinction. The projects involved significant efforts in modeling (creating equations), analysis (understanding properties of solutions) and simulations (solving numerically).

Students who worked on these projects were **Abigail Bernasconi**, **Elizabeth Rayona Riutta** and **Darwin Nesheim**.

“I have been interested in mathematical modeling for a long time and seeing this opportunity come up was fantastic!” said Nesheim, a sophomore majoring in mathematics.

A third set of projects supervised by Peszynska are related to phase transitions and porous media flow. The first project involves understanding the effects of climate change on the thawing and refreezing of permafrost. The second project is to create a model to predict the spread of nuclear waste through different media: air, water, and several types of soil. Each project entails examining existing data, then creating a mathematical model, and finally simulating the solutions in MATLAB.

The students working on these projects were **Nathanael Bowles** and **Anneli Brackbill**. Brackbill is an honors college double major in nuclear engineering and mathematics, with an applied and computational mathematics option. Bowles is a first-year transfer student majoring in mathematics. He went to an art-focused middle school and high

school, so going from theater, choir and photography to mathematics has been a very interesting process for him, explains Bowles.

“I have been interested in mathematical modeling for a long time and seeing this opportunity come up was fantastic!”

- Darwin Nesheim

All students met weekly with the mentors for 15 weeks from the middle of winter 2019 to the end of spring term 2019. Each participant is expected to present their results either at the Celebrating Undergrad Excellence Symposium in May or the Summer Undergraduate Research Symposium in September. Students also participated in a professional development workshop sponsored by the URSA Engage program.

Mathematics students have also been successful in obtaining funding from the SURE Science Program, a competitive College of Science summer research grant program available to full-time science undergraduates. The scholarship provides financial support over the summer so students can focus on conducting research. Bowles received the SURE Science scholarship for summer 2019 to continue working on the URSA project. Other mathematics majors receiving awards this year are Jin Kiatvongcharoen and Wanling Xie.



2019 LONSETH AWARDS

Joel Davis Award for Excellence in Mathematics

Aaliyah Fiala and Benjamin Sharkansky

Botond Gabor Eross Memorial Scholarship

Anthony Netz, Mattia Carbonaro and Michael Kupperman

Edward H. Stockwell Award

Francisco Bolanos, John Meo, Jeremy Shahan and Megan Tucker

Harry and Molly Goheen Memorial Scholarship

Justin Bloom

Actuarial Science Award

Andrew Colburn and Sally Fletcher

Gary L. Musser Award

Camryn Kimberly

WIC Culture of Writing Award

Sara Tro

COMAP MCM Meritorious Winners

Sara Tro, Andrea Lanz and Michael Kupperman

William F. Burger Graduate Teaching Award

Sarah Hagen

Outstanding Performance in Coursework Award

Michael Allen, and Naren Vohra, Paul Dalenberg, Chung-Ping Lai, Slade Sanderson and Benjamin Toomey

Graduate Student Award for Excellence in Qualifying Exams

Patrick Donaghue and Leah Sturman

Graduate Student Excellence Award

Naveen Somasunderam

OUT THERE

Diversity, outreach, news and events

Mathematics faculty and students are involved in extensive outreach and efforts to promote diversity and inclusion. Below are just a few highlights from our significant activities in 2018-19.

Building community in the mathematical sciences

The Department of Mathematics became a silver member of the Center for the National Alliance for Doctoral Studies in the Mathematical Sciences in 2018. Professor **Vrushali Bokil** and graduate student **Branwen Purdy** represented the mathematics department at the 2018 Field of Dreams conference held during November in St Louis, Missouri. Each fall, Alliance Scholars, together with their Alliance Mentors, are invited to the Field of Dreams Conference which introduces potential graduate students to graduate programs in the mathematical sciences at Alliance

schools. Bokil and Purdy hosted information sessions and tables at the conference to introduce prospective students to the research experiences for undergraduates and graduate programs in mathematics at OSU.

Several mathematics faculty members also participate in the Math Alliance Facilitated Graduate Applications Process (F-GAP), an Alliance program that provides undergraduate seniors and masters students with the advice and assistance needed to begin the application process as they consider applying to graduate programs.

Malgo Pesynska has mentored one to two F-GAP mentees for the last several years. Bokil became an F-GAP mentor last year and is currently mentoring one student.

Enhancing inclusivity and supporting the queer and trans communities in mathematics

Graduate student **Michael Lopez** is passionate about making mathematics learning more diverse and inclusive. After giving a talk in the mathematics graduate seminar, "Building Diverse, Inclusive, Respectful and Welcoming Mathematical Communities," offered by Vrushali Bokil in winter 2019, Lopez was inspired to create a four hour inclusive training workshop for the mathematics department. For this, he solicited the help of Jeff Kenney, Director of Institutional Education for Diversity, Equity & Inclusion.

Three mathematics faculty, Dan Rockwell, Elizabeth Jones, and



Vrushali Bokil, participated with Michael in the inclusive training workshop to understand issues and develop a support system for our LGBTQ community here at OSU. The interactive workshop, titled, "Queer and Trans Issues in Higher Education: Knowledge and Skills for Advocacy," utilized group activities to raise participants' consciousness about contemporary queer and trans issues in higher education.

Improving first-year student transition experience

In fall 2018, OSU launched a pilot voluntary faculty-student mentor program (FSMP) to increase retention and graduation rates overall and reduce the opportunity gap for underrepresented minorities, first-generation, and Pell-eligible students. The program focused on improving the student transition experience. Eleven mathematics faculty participated in the FSMP in 2018-19: Tom Schmidt, Adel Faridani, Bill Bogley, Filix Maisch, Dan Rockwell, Vrushali Bokil, Nathan Gibson, Elise Lockwood, Enrique Thomann, Juan Restrepo and Holly Swisher. Each faculty member was



Dan Rockwell facilitates the "tic-tac-totally crazy" activity for school children during Discovery Days.

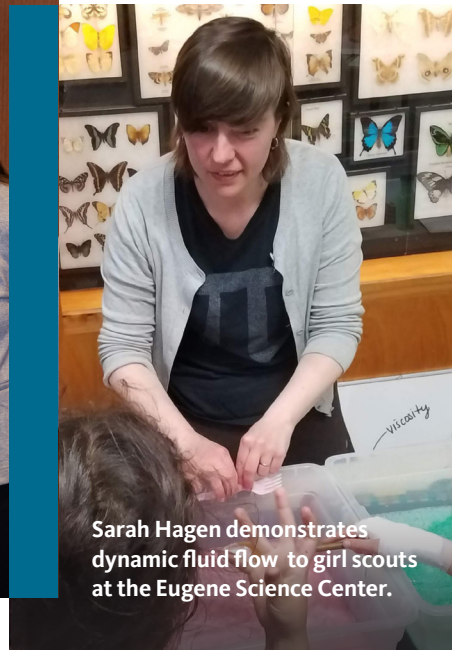
Vrushali Bokil (middle) was a faculty mentor in the Faculty-Student Mentor Program.



paired with 1-5 first year students and one peer mentor, the entire group meeting five times every quarter in the fall, winter and spring quarters of 2018-19. By volunteering their time, mathematics faculty are contributing to increasing first-year retention rate, which currently is about 85% for Pell-eligible, first-generation, and underrepresented students, to reach OSU's goal of 90% retention rate.

Encouraging women to pursue mathematics

A lucky group of 123 middle-schoolers from across the Willamette Valley visited OSU's campus on March



Sarah Hagen demonstrates dynamic fluid flow to girl scouts at the Eugene Science Center.

3, 2018 to attend Discovering the Scientist Within, a free annual workshop designed to encourage young women to pursue science, technology, engineering and mathematics (STEM) careers. The workshop is sponsored by the College of Science, OSU Precollege Programs and STEM Academy @ OSU.

Associate Professor **Mary Beisiegel** opened the morning with an inspirational talk about her own unconventional path from a struggling mathematics student to becoming a mathematics professor and a nationally recognized teacher. She encouraged

the young women to believe in themselves, to work hard and find people and mentors to support them.

This past year saw the invigoration of our local chapter of the Association for Women in Mathematics (AWM) under the leadership of graduate students **Branwen Purdy** as president, **Sarah Hagen** as vice president, **Diana Christofferson** as secretary and faculty advisors **Vrushali Bokil** and **Holly Swisher**. AWM members ran a mathematical games workshop for middle school girls as part of the February 2019 Discovering the Scientist Within event at OSU. They ran a mobius strip activity for elementary school children at the Discovery Days event in spring 2019.

For Mathematical Marvels Day at the Eugene Science Center, Hagen developed and ran a demo, along with AWM members, on the mathematics of fluid dynamics called Order and Chaos in Fluid Flow. This summer, Sarah gave a talk on the geometry of ancient Greek astronomy at a 500 Women Scientists event in Eugene. She has also given several other mathematical talks including "How Big is Infinity?" In addition, Hagen and Purdy are also founding members of the newly formed Graduate Student Outreach Council in the College of Science.

Automata and computational complexity at the 34th annual Lonseth Lecture

The Department of Mathematics hosted Professor **Mai Gehrke** from the Laboratoire Jean Alexandre Dieudonné at the Université Côte d'Azur in Nice, France, who delivered our 34th annual Lonseth Lecture on April 19, 2019. Gehrke gave a talk titled, "Using abstract mathematical structures to study algorithmic

complexity questions." Gehrke discussed automata, which are very simple computational models. They are important in applications of computer science but also serve as a laboratory for studying the complexity of algorithms. Gehrke introduced automata and showed how finite monoids, certain very abstract

algebraic structures, may be assigned as invariants of automata. Illustrating how these invariants are powerful enough to make deep computational questions decidable, she gave a glimpse at how this can be generalized to provide sophisticated mathematical tools for the study of computational complexity classes.