Fall 2016

{ Math News }

A publication of the Department of Mathematics at the University of Nebraska–Lincoln

A hand-painted mural fills the entire east wall of the new math lounge in Avery Hall.

DEB KLIMES/ UNL CSMCE

New undergraduate lounge opens

Aiming to create a space in Avery Hall designed for undergraduate mathematics students, the Department of Mathematics has opened a new undergrad lounge this fall. Formerly a computer lab, 18 Avery has been updated and converted to convenient study space and even features a hand-painted mathematics mural along one wall.

"We wanted to give students with similar interests a way to grow their network of peers and friends among the math majors," said Daniel Toundykov, associate professor and faculty adviser for Math Club. "Already at the first formal opening event, I saw many familiar faces but this was the first time for many of these students to introduce themselves to one another."

Former department chair and now associate vice chancellor Judy Walker initiated the project in 2014, and staff member Lori Mueller oversaw the renovations. Early on, the department gathered feedback from the students about how they would like to see the room redesigned.

See LOUNGE *on Page 7*

VIEW FROM THE CHAIR

Tom Marley

Greetings, friends of the department. I hope this newsletter finds you well, and that 2016 has been a happy and successful year. As you probably are aware, it has been a year of transitions at Nebraska, starting at the top with the appointment of IANR Vice Chancellor Ronnie Green as UNL's new chancellor. The ripple effects of this appointment eventually made their way to our department, with former Chair Judy Walker's appointment as interim associate vice chancellor for academic affairs, and subsequently my appointment as interim chair of the department. The dominoes

See CHAIR *on Page 12*

INSIDE:

MATTHEW MINARD/BAYLOR

Research News

KNOT THEORY

Study of knots brings connections

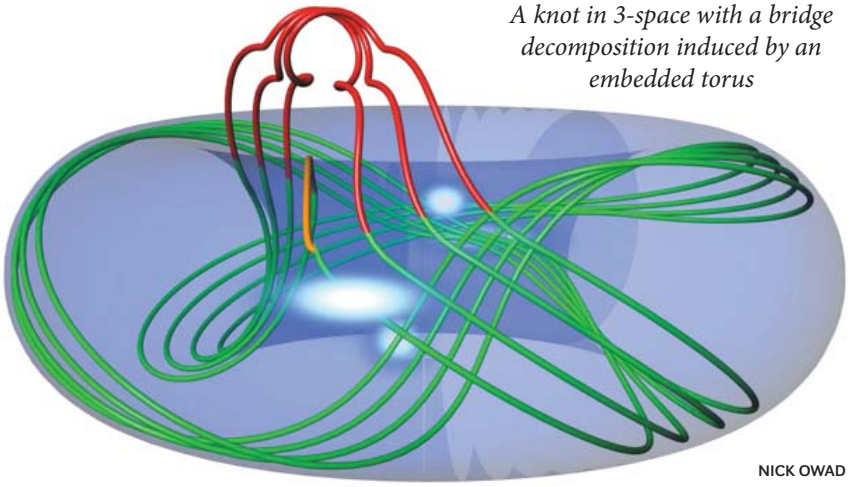
Imagine taking a tangled extension cord and plugging it into itself, so that it forms a closed loop. Can it be untied without unplugging the end? If not, can you prove it?

Topology is the study of mathematical spaces up to smooth deformations — stretching, twisting, bending — that do not break the space. Like many problems in topology, it is intuitively obvious that a closed, knotted loop can't be untied, but backing up this intuition with mathematical rigor can be much more complicated.

Knot theory — the study of knotted loops in 3-dimensional space — was developed in the 19th century, motivated by the mistaken proposition of Lord Kelvin that every atom was actually a knot in the ether, a ubiquitous substance composing all matter, and different types of atoms corresponded to different types of knots. This theory was debunked in the early 20th century, but knot theory persisted on its own, first as a mathematical curiosity, then emerging as one of the centerpieces in low-dimensional topology over the last 50 years.

Ethereal connections notwithstanding, knot theory can be applied to any number of physical contexts, including biology and chemistry. Perhaps most notably, Edward Witten earned a Fields Medal (the only physicist to do so) in part by discovering deep connections between knot invariants and fundamental concepts in physics.

An invariant of a knot is a function that takes a knot as input and outputs another mathematical structure, such as an integer, a polynomial or a group. Invariants are, in a way, like a blood type — if two blood samples have different types, they must have come from different individuals. Similarly, if two knotted loops have different invariants, they must be distinct knots.



A knot in 3-space with a bridge decomposition induced by an embedded torus

NICK OWAD

Various faculty members in the department have been conducting research to better understand these structures, including Mark Brittenham, who has been publishing papers in knot theory for nearly 20 years. Most recently, Brittenham is working to better understand the unknotting number of a knot, which in some sense measures how "close" a particular knot is to being unknotted. He has implemented an exhaustive computer search to determine new unknotting numbers, with great success; his work is now included in KnotInfo, a comprehensive database of knots and their invariants maintained by Indiana University and used by researchers all over the world.

Alex Zupan, who joined the faculty in the fall of 2015, is studying another classical knot invariant, the bridge number of a knot. Every knot K can be cut into two collections of unknotted arcs by an embedded plane in 3-dimensional space, and the bridge number of K is number of arcs in a minimal such decomposition. Much of Zupan's work as a postdoctoral researcher at the University of Texas at Austin involved understanding decompositions coming from other, more complicated surfaces, determining properties about a sequence of these invariants, called the bridge spectrum. Following the completion of that work, he adapted the notion of bridge number to dimension four, finding a new invariant of knotted surfaces in four-dimensional space.

Zupan's arrival neatly coincided with recent UNL graduate Nick Owad's dissertation year (2015-2016), as Owad's thesis work extended Zupan's results about the bridge spectrum to new families of knots. Owad is but one in a long string of graduate students advised by Brittenham and/or Susan Hermiller and doing research in various topics in knot theory.

Like Brittenham, both Melanie DeVries (Ph.D., '13) and Anne Kerian (Ph.D., '15) were interested in unknotting numbers of knots, with DeVries extending ideas to the broader context of virtual knots, and Kerian discovering new unknotting results for a specific knot family.

The research group has also included undergraduate students. For instance, Lucas Sabalka — who

See KNOT THEORY *on Page 12*

NSF SEMINAL GRANT

Fostering active learning in calculus

LINDSAY AUGUSTYN/UNL CSMCE

Undergraduate learning assistant Meredith Hovis (left), a secondary mathematics (6-12) major, facilitates group discussions with students in a Math 101 course.

The University of Nebraska-Lincoln has received a National Science Foundation grant designed to help mathematics departments adopt more effective instructional methods at the undergraduate level.

Alongside the University of Colorado Boulder, San Diego State University and the Association of Public and Land-Grant Universities, Nebraska's Department of Mathematics will investigate how incorporating active-learning strategies can improve the instruction of precalculus-to-calculus 2, or P2C2.

Active learning consists of teaching methods and classroom norms that promote deep engagement in mathematical reasoning, peer-to-peer interaction and instructor inquiries into student thinking. Education research has shown that active-learning techniques are significantly better than traditional instructional approaches.

"The project will benefit the mathematical sciences community by improving student success in high-enrollment undergraduate courses, better preparing those students who go on to STEM majors, and improving the teaching of future faculty through the mentoring of graduate students," said Wendy Smith, associate director of the Center for Science, Mathematics and Computer Education and Nebraska's project lead.

Nebraska will split $1 million of the $3 million NSF grant, with the additional $2 million going to the APLU for institutions that will join the project in its second phase. In addition to Smith, the Nebraska team includes Allan Donsig, vice chair of the Department of Mathematics, and Nathan Wakefield, director of first-year mathematics programs.

Nebraska already has invested considerable resources into implementing active learning in precalculus, according to Donsig. Along with dedicating classrooms for group work, the department has extended the length of classes in precalculus and calculus to account for the extra time needed to implement active-learning strategies. And instead of passively watching as teaching assistants solve problems on the board, students in calculus recitations now collaborate to find the solutions themselves.

The department hired Wakefield as coordinator of the four precalculus courses, a role in which he oversees the training and mentoring of graduate teaching assistants. It also hires undergraduate learning assistants to help with the precalculus courses and facilitate group discussions. Taken together, these changes have significantly improved student success in precalculus, Donsig said. The department is now working to extend these results to its calculus courses.

"In spite of compelling results at some universities, including Nebraska, student-centered approaches to teaching precalculus and calculus are rare," Donsig said. "We want to enable other institutions to take full advantage of active-learning methods as we understand and scale up the process of institutional change."

The project will lead to important strategies for adapting, implementing, supporting and assessing active learning in P2C2 courses, Smith said. Strategies will be based on case studies of institutions that have successfully adopted active-learning techniques, starting with the grant's core institutions before expanding to a larger group.

"There is an extensive body of literature that demonstrates the effectiveness of active-learning techniques," Wakefield said. "We are looking to take this literature from the research level to the practitioner level, not just on the scale of individual instructor but on the scale of an entire program."

– Lindsay Augustyn

Project aims to boost women in math grad programs

CRAIG CHANDLER/UNIVERSITY COMMUNICATIONS

Associate Vice Chancellor Judy Walker (left) discusses a math question with doctoral students Erica Miller (center) and Allison Beemer. Walker leads a new National Science Foundation-funded project to increase the number of women in mathematics, especially at the doctoral level.

Despite advances since Judy Walker graduated as one of just a few women in her doctoral mathematics program 20 years ago, today only a quarter of U.S. math doctorates go to women. The mathematics profession must take responsibility for diversifying its doctoral program graduates, said Walker, Aaron Douglas Professor of Mathematics and interim associate vice chancellor for academic affairs at the University of Nebraska-Lincoln.

Walker heads a new project aimed at increasing the number of U.S. women with mathematics doctorates. It was one of 37 projects nationwide funded through the new National Science Foundation INCLUDES program to broaden participation in science, technology, engineering and mathematics, or STEM fields, by improving educational opportunities for underserved populations.

The award acknowledges the university's national reputation as a leader in promoting diversity in mathematics education, Walker said.

The two-year, nearly $300,000 grant funds a pilot project to research existing programs and to develop new educational models that support women in math, including minority women. Walker is teaming with mathematicians at California's Pomona College, Massachusetts's Smith College and Minnesota's Carleton College.

Generating momentum within the academic community is a key aspect of the project. Increasing women's participation improves opportunities for everyone, Walker said. Math is the foundation for advancing numerous science, technology and engineering fields. People with math doctorates are in high demand in many growth sectors, including national security, technology and finance.

"If you're ignoring half your workforce, then you're ignoring potential," Walker said.

Stereotypes about women's math abilities, societal pressure and a lack of role models and peer groups contribute to the historically low numbers of women math professionals.

"If you take an isolated woman or member of a minority group and put them in a situation where people don't think they're going to succeed, they probably won't," Walker said. "You need a culture that supports their success if they're going to succeed."

Several programs geared toward countering these obstacles have been successful, including the university's annual Nebraska Conference for Undergraduate Women in Mathematics. The team will research these programs to identify the important aspects that can be developed into cost-effective approaches that reach a larger audience. Patricia Wonch Hill, research assistant professor in sociology, will work with Nebraska's Bureau of Sociological Research to interview participants and coordinators as well as graduate program directors and those who hire people with doctorates in math.

NSF INCLUDES PROGRAM

In addition to the university's annual women in mathematics conference, the team will review three other successful programs geared toward undergraduate or graduate students: EDGE, a summer residency and mentoring program administered by Morehouse and Pomona colleges; the Carleton College Summer Mathematics Program for Women; and the Post-baccalaureate Program at Smith College.

Participants and others in the math community will meet to begin developing math educational prototypes based on research results. The grant also funds a website to compile resources and information for female math students.

A national advisory panel of prominent mathematics community members will help distribute results and encourage participation in educational reform across the profession.

INCLUDES, which stands for Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science, is investing in developing partnerships and alliances across award winners, philanthropy, government and professional societies to strengthen education diversity across STEM fields. Nebraska will participate in these national alliances.

"The University of Nebraska-Lincoln is uniquely positioned to house this project," Walker said. "If you ask people in the mathematics community nationally which math departments are doing it right, everyone is going to say Nebraska. Absolutely, no doubt."

– Gillian Klucas, Research and Economic Development

PI MU EPSILON LECTURE

COURTESY PHOTO

Twelve Nebraska students were inducted into the Nebraska Alpha Chapter of Pi Mu Epsilon on Oct. 7, 2016, before a lecture given by David Saltman of the Center for Communications Research (fifth from left).

Breaking Enigma ... the first time

Saltman describes how Polish mathematicians first decoded messages

The 10th Annual Pi Mu Epsilon Lecture was given by Dr. David Saltman on Oct. 7, 2016.

Saltman is the director of the Center for Communications Research, a federally funded research and development center in Princeton, New Jersey. Formerly, he was the Mildred Caldell and Baine Perkins Kerr Centennial Professor of Mathematics at the University of Texas in Austin. David Saltman is well known for his remarkable research contributions in algebra and number theory.

During his stay at Nebraska, Saltman met with students to offer his perspective on academic vs. non-academic employment, gave a colloquium talk for faculty and graduates, and presented the 10th annual Pi Mu Epsilon address "Breaking Enigma the First Time."

"Enigma" was the name given to the cipher machines that the German Armed Forces used to safeguard their communications during World War II. The lecture featured a real Enigma unit that the audience had a chance to try out. Saltman described the fundamentals of its construction wherein any position of rotors defines a permutation of the alphabet by mapping each letter to another one. Every keystroke rotates the rotors and thus yields a new permutation for each next character. The encoded message can be read on any other Enigma machine by entering the resulting combination of letters, provided the two Enigma units had the same starting rotor configurations.

LINDSAY AUGUSTYN/UNL CSMCE

"Enigma" was the name given to the cipher machines that the German Armed Forces used to safeguard their communications during World War II. This machine is one of the few left.

The story of how the Allies broke the Enigma codes (and kept it a secret from the Nazis) is a compelling and important one. The course of the war might have been far different without the vital intelligence gained by reading Enigma messages. However, the breaking of Enigma started with the lesser known work of three Polish mathematicians and cryptanalysts Marian Rejewski, Jerzy Rozycki and Henryk Zygalski. The first key weakness of the machine they exploited was the fact that the starting rotor position had to be transmitted in the clear, after which an operator

See ENIGMA *on Page 6*

ENIGMA *From Page 5*

would choose a secret key that would be sent over twice (to avoid errors). Though the rotor structure was not fully known, the beginning of such a message had relations between the 1st and 4th, the 2nd and 5th, 3rd and 6th, etc., characters. This information along with other clever insights could be used to successfully decode many Enigma messages.

The Germans kept updating the machine and changed communication procedures. Rajevsky and his team in the Polish Cipher Bureau were quick to respond by developing more sophisticated decoding methods. Yet in 1939 it became apparent that their resources were insufficient to keep pace with the evolution of Enigma encryption. The Polish General Staff and government decided to initiate their Western allies into the secrets of Enigma decryption. The Polish methods were then revealed to French and British intelligence.

The Enigma study during WWII was led by the British and the genius of Allan Turing – a mathematician, logician, theoretical biologist and regarded as the 'father' of theoretical computer science. Turing led the section responsible for German naval cryptanalysis. He devised a number of techniques for speeding the breaking of Enigma ciphers including an electromechanical machine that could find the rotor settings for the Enigma.

One of the most difficult research questions is often not computing the solution, but proving that one exists to begin with. ... They proved that Enigma *could* be broken.

In light of these latter successes, the pioneering efforts of the Polish cryptanalysts are less well known. One may even wonder if their work was truly indispensable. Yet, it is hard to forget that one of the most difficult research questions is often not computing the solution, but proving that one exists to begin with. Rajewski and his team provided not merely an impetus and a knowledge base for further study of Enigma, their monumental achievement was to solve the greatest mystery of this cipher device: They proved that Enigma *could* be broken.

– Daniel Toundykov

LINDSAY AUGUSTYN/UNL CSMCE

Professor Susan Hermiller touches the Enigma machine brought to Nebraska for the 10th annual Pi Mu Epsilon Lecture given by David Saltman as others line up to take photos with the machine.

KUMUNUjr

Giving grads, postdocs a chance to share research

For the last five years, a conference specifically for graduate students and postdocs to share their research has been held at Nebraska. The KUMUNUjr conference (standing for the University of Kansas, the University of Missouri, and the University of Nebraska-Lincoln) was inspired by the KUMUNU conference that historically focused on faculty research.

The conference is currently organized by UNL graduate students Seth Lindokken, Brittney Falahola, and Luigi Ferraro.

The goals of KUMUNUjr are to:

- enable collaboration and mentoring relationships among young researchers;
- include graduate students from universities with small commutative algebra research groups; and
- provide exposure to different types of problems in commutative algebra.

The conference typically runs during a weekend toward the end of the spring semester. On Saturday, there is a full day of talks followed by an informal social gathering. The conference picks up again on Sunday for another half day of talks before drawing the conference to a close.

In 2012, there were 14 non-UNL participants who attended the conference. As of the most recent conference (Spring 2016), that number has risen to 26.

The speakers at the most recent conference came from a variety of institutions including Arkansas, Michigan, Texas at Arlington and Virginia, as well as Kansas, Missouri and Nebraska.

The next KUMUNUjr conference will be held April 8-9, 2017.

- Seth Lindokken

LOUNGE *From Page 1*

During her senior year, mathematics and art major Jenny May created the mural (see sidebar at right) before she graduated in May 2015, along with the help of faculty members Michelle Homp, Alexandra Seceleanu and Toundykov.

"The entire mural elegantly ties together many different areas of mathematics that our students encounter in the courses they take, including, for example, Calculus, Math 221, 310, 325, 452 and 380," Toundykov said. "I think the mural carries a nice educational component, since merely viewing it prompts one to learn or revisit the beautifully depicted concepts."

Mueller added coating to the mural when it was finished and created "Pi" graphics for the multi-touch light control screen on the wall. Mueller also redesigned the entire room, from paint colors to the type and placement of the whiteboards – including adding whiteboards to the columns. Graduate student Nick Owad, who earned his Ph.D. in August, contributed several 3D-printed mathematical shapes to decorate the lounge.

"It is such a cool place," said senior math major Cash Bortner. "I wish I had had this space as a freshman. We have couches upstairs, but people are always walking through, and there isn't any board space. This is fantastic."

The undergrad lounge uses N-card access currently enabled for undergraduate mathematics majors. The lounge will be open for students when the building is open, and it will not be reserved for any special events. For example, Math Club activities will be held in other auditoria.

New furniture also has been selected for the room, but funding from donors is being sought to enable that purchase.

"This lounge is a place that will further knit together the community of math students and help them to realize how large their group truly is," Toundykov said. "Ultimately we hope to see more new lounge visitors as they formally declare mathematics among their major choices."

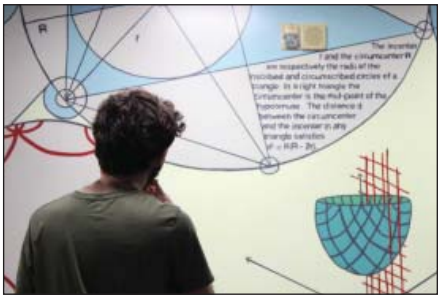
- Lindsay Augustyn

Mural artist reflects on process

Mural artist Jenny May, an Omaha native who went to Marian High School, graduated in May 2015 from UNL with a dual major in math and art. After graduation, she spent a few months traveling, but is currently back in Omaha, working in life insurance, with a goal of traveling more in the future. May keeps busy with art commissions and works on figure drawings and digital paintings.

How did you hear about the mural project and get selected to paint it?

"In the spring of 2014, I was just beginning to organize a Women in STEM workshop. During the research portion of this project, I met with Judy Walker to discuss the support system in place for female graduate students in mathematics. When Dr. Walker found out I was a math and art double major, she mentioned the mural as a project the department had been contemplating. I told her I was very interested, and from there she got me in contact with Dr. Michelle Homp and graduate student Nick Owad, and we began to ideate."



DEB KLIMES/UNL CSMCE

How did you decide what the mural would look like?

"The mural went through dozens of designs and a lot of changes over the 18 months we worked on it. I had input from professors in all areas of mathematics, as well as images from mathematics textbooks and journals to use for inspiration. The goal was to make something beautiful yet mathematically sound, a balance that was difficult to strike at times. The input of better mathematicians was invaluable, and I think it was a fun exercise to ask professors what the 'prettiest' part of their specialty was. I learned many mathematicians have an artistic streak that loves the beauty of math as much as they love the truth of it."

What is your favorite part of the mural?

"My favorite part of the mural is probably the direction field. I really got mired in the details while painting it, but when I stepped back and saw the finished product, I was very pleased. Kind of a metaphor for the whole mural."

How many hours do you think it took you to paint it, and what was your process?

"The whole painting process probably took 50 hours. I used a projector to get the design on the walls and started by sketching the whole thing out. Since the room is small and the walls curved, there was a fair amount of free-handing here as well. I then had a few volunteers in the math department help me fill in the large yellow sections of the background, which would have been slow-going alone. I loved the peace and quiet of working alone – the whole thing was very meditative. It was a great capstone to my math studies, like a visual tour of the last four years of my education."

How do you feel about how the mural turned out?

"Being able to physically paint it on the wall was tremendously satisfying, and being involved in this project was one of the best things I ever did at UNL. I'm so proud of the way the mural came out. I've also found myself missing my math classes deeply, and recently bought a couple of math textbooks I've been reading for fun. Never thought I'd be that person who digs back into trig in her free time! Hopefully the students enjoy looking at the mural – some of them might even learn something; I know I did!"

HOWARD ROWLEE LECTURE

Slime molds and societies

Jordan Ellenberg, the John D. MacArthur Professor of Mathematics at the University of Wisconsin-Madison, gave the 20th annual Howard Rowlee Lecture, "There's No Such Thing As Public Opinion," on March 17, 2016.

Ellenberg's mathematical research has been wide ranging, centered on arithmetic algebraic geometry. He also has written about mathematical topics for the "New York Times" and the "Washington Post," among other national news outlets. He is the author of the book "How Not to Be Wrong: The Power of Mathematical Thinking," of which the "Wall Street Journal" wrote, "It will help you realize that mathematical reasoning permeates our lives – that it can be, as Ellenberg writes, a kind of 'X-ray specs that reveal hidden structures underneath the messy and chaotic surface of the world.' "

In his lecture, Ellenberg discussed a number of perspectives on how individual preferences combine to form the preferences of large groupings, such as societies or slime molds. He first asked his audience to imagine a society (Lincolnica, say) in which each person held one of the following, entirely rational, opinions about the right way to reduce their national deficit: one-third felt that the government should raise taxes; one-third thought that cutting defense spending is the way to go; and one-third knew in their hearts that cutting Medicare is the solution.

How do these seemingly reasonable individual preferences translate into public opinion? Two-thirds of the country oppose raising taxes. A different two-thirds resist cutting defense. And two-thirds can't abide cuts to Medicare. This leads to newspaper editorials about the obvious fact that Lincolnicans are crazy and don't know how the world works. Ellenberg argued that such apparent irrationalities in public opinion are the inevitable outcome of trying to combine individual preferences into group preferences.

LINDSAY AUGUSTYN/UNL CSMCE

Jordan Ellenberg of the University of Wisconsin-Madison gives the 20th annual Howard Rowlee Lecture, "There's No Such Thing as Public Opinion," on March 17.

A more successful example of these sort of combined preferences comes from the inner life of Physarum polycephalum. Most of the time this is a one-celled, amoeba-like organism, but under the right conditions it forms a colony, a plasmodium consisting of networks of protoplasmic veins, and many nuclei. In its colony form, sans brain, sans nervous system, this slime mold makes decisions. As Ellenberg writes in his book: "... good decisions. In the slime mold's limited world these pretty much come down to "move toward things I like" (oats) and "move away from things I don't like" (bright light). Somehow the slime mold's decentralized thought process is able to get the job done very effectively. As in, you can train a slime mold to run through a maze. (This takes a long time and a lot of oats.)"

When grown in Petri dishes with multiple food sources, slime molds build efficient networks to consume all the available food. Researchers in 2010 used oats to represent Tokyo and 36 surrounding towns. P. polycephalum created a network similar to the existing train system, "with comparable efficiency, fault tolerance and cost."

As a third example of how individual preferences become group decisions, Ellenberg discussed elections, or, as he described them, "big cast-iron meat grinders, into which go individual choices, and out of which comes the sausage goop called the – popular will." He discussed the Borda count, a single-winner election method in which voters rank options or candidates in order of preference, and candidates receive points on each ballot according to how many alternatives are ranked lower than they are. This might or might not be a good idea for national elections, but scientists who have studied slime molds suggest that their brainless decision-making might be explained by a Borda count-like democracy of cells.

One shouldn't leap to the conclusion that slime molds brainlessly get everything right; they are subject (experimentally) to failures of rationality, such as the asymmetric domination effect, that support this model of their decision processes. On the other hand, we probably shouldn't brag. Humans are (experimentally) subject to the same failures.

– Jamie Radcliffe

From farm to finance for Hegemann

While growing up on a farm in Belvedere, Nebraska, Mary Hegemann knew she loved math. What she didn't know yet was whether there was a job out there that involved doing calculus for pay.

By the time she arrived at the University of Nebraska-Lincoln as an undergraduate, she had found actuarial science and chose to major in it, along with mathematics.

She was attracted to the respect people have for the actuarial science industry, and "this was the closest thing to doing calculus and algebra all day that I enjoyed," Hegemann said.

On Nov. 10, 2016, Hegemann spoke to Nebraska students at lunch and again at the third Career Perspectives in Mathematics lecture, funded by the Bares Family Fund for Excellence in Mathematics. Hegemann, who graduated from UNL in 1996, is now a principal and part owner of Wakely Consulting Group in Denver, Colorado.

Hegemann, FSA, MAAA, shared her experiences at Nebraska and what she looks for when hiring students.

"I promote people who can write," Hegemann said. Technical writing ability, such as understanding grammar and being able to put your thoughts on paper succinctly, is of the utmost importance, Hegemann added.

LINDSAY AUGUSTYN/UNL CSMCE

Mary Hegemann (center) of Wakely Consulting Group speaks to students on Nov. 10, 2016, at lunch before her Career Perspectives in Mathematics lecture.

Hegemann manages Wakely's Denver and Minneapolis offices and helped start the Denver office in 2008. Wakely has over 85 employees nationwide and is the largest employer of actuaries in the health care field.

With over 20 years experience as an actuary, Hegemann has had extensive experience with public programs including Medicare, Medicaid, Affordable Care Act reform, and safety net programs for low-income populations. She has been the lead consulting actuary for Robert Wood Johnson, educating states regarding the financial implications of the ACA. She also provides budget projections for state Medicaid agencies, actuarial certifications for Medicare products to CMS, and consults clients in the development of benefits and calculation of premiums for commercial insurance products.

"Change is opportunity in this industry," she said. "Our firm tries to get ahead of the curve and tee up solutions before our competitors do."

Hegemann said her greatest successes include being happily married for 21 years and raising two children.

– Lindsay Augustyn and Alexandra Seceleanu

High schools finding great value in Math Day

Not only did a record number of students register for Nebraska Math Day on Nov. 17, three schools also attended for the first time.

Crete High School, Mitchell Jr/Sr High and Santee High School made an inaugural trip to this 27th annual event.

"We decided to bring our students to Math Day for the first time this year because it not only promotes UNL and the great math program that it has, but it helps open our students' eyes to the opportunities that are within reach for them," said Tony Jacobsen, a math teacher at Crete. "Math Day may even push some of our students to pursue a math career after they see all of activities that Math Day has in store for them. Our students will enjoy the challenge of a math competition so they can see how they stack up against students from other schools."

Nearly 100 Nebraska high schools registered to bring 1,724 students to Math Day, which occupies rooms in the Nebraska Union, Gaughan Center and Wick Alumni Center.

On the day of the 2016 event, 1,524 students from 97 schools took the PROBE I exam. Omaha Central High brought 75 students, Wahoo 70 and Scottsbluff 63. Darrel Chew of Omaha North took first place in the scholarship competition.

Three other schools returned to the event after a long hiatus. Plainview High attended for the first time since 1999, Humboldt Table Rock Steinhauer since 2005 and Heartland Community Schools since 2006.

– Lindsay Augustyn

Faculty News

John's Journal

A semester in China: by John Meakin

Xi'an, China, November 2016 – In the fall of 2015, I met with a small delegation of people from Xi'an Jiaotong University (XJTU) in China. The delegation visited Nebraska as part of a relationship between the two universities that was established several years ago, and that led to the establishment of a Confucius Institute at Nebraska and a burgeoning academic exchange program between us and XJTU. The delegation from XJTU included a dean of the science college and Professor Zhu Xu, a mathematician at XJTU, who asked whether I might consider teaching an algebra course in Xi'an some time. After thinking about this for a couple of months, I decided that it might be an interesting experience to do this, since by then I had retired. I contacted Professor Zhu and made arrangements to spend the fall semester of 2016 at XJTU. My wife, Glory, and I traveled to Xi'an at the end of August 2016. As I write this, we are nearing the end of a rather fascinating three-month visit to China.

The Work Experience

XJTU is well known across China and attracts some very good students. The math department is heavily applied, with primary strengths in areas like numerical analysis and partial differential equations. They have about 800 math majors as best I am able to determine. There is one young faculty member in low-dimensional topology (my primary mathematical contact at XJTU), but no algebraists on the faculty. However, they teach a balanced undergraduate curriculum, with a clearly applied emphasis.

My agreement with XJTU was to teach a rigorous course in modern algebra to an undergraduate honors class consisting of around 35 very bright second-year math majors. I discussed the course and the expected background of the students before traveling to Xi'an, and it was clear that the course was to be at a level like a senior undergraduate/beginning graduate level course at Nebraska. So I designed a course that is roughly like our 817/818 course (group theory through the Sylow theorems, some ring theory with a focus on polynomial rings, enough module theory to include finitely generated modules over principal ideal domains, and enough field theory to enable a brief introduction to Galois theory). The course met six hours a week for about 11 weeks, so it was quite intense, both for me and for the students. There were homework assignments, a midterm exam and a final. The course was in English, which was something of a barrier for some of the students I think, although they all understood English at some level. My colleague in topology graded papers and offered general advice, which was a good thing since some of the students wrote their solutions to exam problems in Chinese.

The best students in the class were as good as the best undergraduates I encountered during my years on the faculty at Nebraska. A few of the students did not put in the effort to keep up with the material and did not do well in the class. Since my class was for honors students, all of the students in the class had essentially the same class schedule and migrated in between classes to another class with the same classmates. They studied mostly mathematics, with some courses in physics and computer science, but no requirements in the humanities, languages or the social sciences. They were by and large serious mathematics students, very interested in learning whatever they could about mathematics, very hard workers, very focused and very

COURTESY PHOTO

John Meakin stands outside the XJTU math department on campus.

disciplined. Class attendance is closely monitored at XJTU, with students required to scan their ID cards at the entrance to each classroom for all of their classes. Many of the students were reluctant to get engaged in class discussions, perhaps in part because they were not sufficiently comfortable with English, but mostly because it did not seem that they had much prior experience in engaging in discussions during class time. However, I did manage to get several of the students to present solutions to homework problems on the board and to discuss solutions to a series of T/F questions that I posed most days.

In addition to the teaching, I suggested to my colleague in topology that we start a weekly seminar in algebra and topology. There are people at different universities in Xi'an with research interests somewhat related to mine, so we organized the seminar on Tuesday nights so that people from several different universities could attend. The seminar went reasonably well, and in fact several of my undergraduate students attended the seminars. I managed to start a promising joint research project with one of my colleagues at another university in Xi'an.

See MEAKIN *on Page 14*

AWARDS AND PROMOTIONS

Allan Donsig has been promoted to full professor in the Department of Mathematics.


Yvonne Lai

Assistant Professor of Mathematics **Yvonne Lai** was presented with the Harold and Esther Edgerton Junior Faculty Award in 2016, which honors an outstanding junior faculty member who has demonstrated creative research, extraordinary teaching abilities and academic promise. This two-year titled position awards the recipient $5,000. Lai's focus is on mathematical knowledge needed for teaching at the high school and college levels. Using her research expertise in mathematical knowledge for teaching, Lai has revamped the department's capstone courses for pre-service high school mathematics teachers, substantially raising the level of rigor and expectations for the students in these courses. "Almost 20 years ago, I knew only two things about Harold Edgerton: his beautiful strobe photography, on display in a hallway at my college, and his dedication to cultivating curiosity in K-12 students. I was awed by these simultaneous passions in art, science, and education. Although this ideal continued to inspire me, I had forgotten its source until I was nominated for the Edgerton award – and a Google search revealed that these Edgertons were in fact the same," Lai said. "I am deeply honored to receive this award. It represents both a charge and inspiration to continue improving my work as a teacher, researcher and communicator." Lai has been in high demand as an invited lecturer, including eight talks in 2015 and nine for 2016. She was elected to the departmental Executive Committee, and she serves as the department's graduate recruiting coordinator.

Wendy Smith, associate director of the Center for Science, Mathematics and Computer Education, was presented with the Boss of the Year Award at the 36th annual University of Nebraska Office Professionals Association bosses luncheon on Nov. 8, 2016. Smith, research associate professor, was presented a $500 cash award, an engraved plaque, and a one-year UNOPA membership.

Judy Walker has been named Nebraska's interim associate vice chancellor for faculty affairs. Walker began her new role July 15, 2016. The appointment's length is expected to be at least one year. The associate vice chancellor for faculty affairs is responsible for addressing faculty issues and professional development, monitoring promotion and tenure, conducting post-tenure review as needed, overseeing academic program reviews and participating in the UNL accreditation process, among other duties.

STAFF NEWS


Alec Kudrna

Alec Kudrna joined the department in October as the administrative technician. He offers general office support, supervises the student workers, makes travel arrangements and provides reimbursements, and updates and maintains the schedule of classes. He looks forward to getting to know everyone in the department as he continues to grow into his new role. Alec was born and raised in Omaha. He earned a Bachelor of Science in business management with an emphasis in information systems from the University of Nebraska at Kearney in 2008. He has spent the last 13+ years in hospitality, getting his start with Mahoney State Park, then working for a year as a college intern for Walt Disney World Resorts, and then finally for the Embassy Suites in La Vista, since it opened in 2008. He recently moved to Lincoln when his wife took a postdoc position in Nebraska's biochemistry department.

NEW FACULTY

Huijing Du

Assistant Professor Du earned her Ph.D. in the area of applied and computational mathematics from the University of Notre Dame, and then she was a postdoctoral scholar at the University of California, Irvine. Her work is in the area of computational and mathematical biology. Du, whose hometown is Henan, China, is serving on the organizing committee for the Nebraska Conference for Undergraduate Women in Mathematics.

Tri Lai

Assistant Professor Lai earned his Ph.D. in mathematics from Indiana University and his Bachelor of Science at Hanoi University in Vietnam. Lai was a postdoctoral associate at the Institute for Mathematics and its Applications, University of Minnesota. His research interest is combinatorics.

Xavier Perez Gimenez

Assistant Professor Perez Gimenez earned his Ph.D. in mathematics from the Polytechnic University of Catalonia. Perez Gimenez, who is from Barcelona, Spain, has research interests in probabilistic combinatorics.

KNOT THEORY *From Page 2*

went on to earn his Ph.D. from UIUC — completed an undergraduate thesis in braid groups, a subject at the intersection of knot theory and group theory, under the direction of Hermiller and John Meakin in 2002.

In addition, the department has seen collaboration in knot theory research among faculty, with Brittenham and Hermiller writing numerous joint papers in knot theory and other topics, often with collaborators from around the world.

Their most recent effort involves UNL postdoctoral researcher Timothy Susse and another noteworthy invariant, the fundamental group of a topological space. This invariant is often used to distinguish two knots, but its impact extends far beyond the realm of knot theory.

Knot theory is closely related to the study of 3-manifolds, where a 3-manifold is a topological space that locally looks like 3-dimensional real space. In September of 2016, Brittenham, Hermiller, and Susse posted a preprint proving the monumental result that if G is the fundamental group of a 3-manifold, then G has a special property known as autostackability. Being autostackable roughly means that a computer with finite memory could be programmed to decide whether a given group element in G, expressed in a complicated way, is actually the trivial element. Although certain types of 3-manifolds were previously known to have this property, this major theorem unifies groups of all 3-manifolds in a clear and elegant way.

While knot theory can be a source of many difficult and longstanding research problems, it is also a wonderfully intuitive and tangible subject, including topics suitable for graduate students, undergraduate students, and even high school students — Zupan taught a mini-course in knot theory for UNL's All Girls/All Math program during the summer of 2016. We look forward to seeing the many exciting directions in which the study of knot theory evolves as a part of UNL's teaching and research mission.

– Alex Zupan

CHAIR *From Page 1*

continued to fall, as Associate Professor Petronela Radu then took over my former post as undergraduate faculty adviser. Despite this upheaval, we are fortunate to have a very seasoned staff (Tom Danaher, Marilyn Johnson, Lori Mueller and the great new addition of Alex Kudrna, see page 11) as well as exceptional faculty in key administrative roles in Vice Chair Allan Donsig and Graduate Chair Susan Hermiller. All of these people have been instrumental in making our department's transition go as smoothly as one might hope. In particular, I want to thank Judy not only for her terrific service as chair of our department for the past five years, but also for the many hours she has generously given me over the past few months to help get me up to speed in this new role.

We had a tremendously successful year in hiring, with three outstanding faculty joining our department in the fall: Assistant Professors Huijing Du, Tri Lai, and Xavier Perez Gimenez (see page 11). We are delighted to welcome them to our department.

The department continues to be a vibrant place where new research discoveries are made and showcased in seminars, colloquia and distinguished speaker series. Last spring the department community was treated with an outstanding talk by Professor Jordan Ellenberg of the University of Wisconsin (see page 8), who spoke about how the apparently irrational decisions of slime molds are leading to new insights in decision science. And this past fall, Dr. David Saltman from the Center of Communications Research gave a talk on the mathematics behind the German Enigma machine and brought with him one of the actual Enigma machines employed during World War II (see page 5).

Our undergraduate program has continued to grow and prosper, with a record number of students declaring mathematics as a major – over 220 (see page 17). Of course, one of the truly exciting events this past year was the opening of our new Undergraduate Math Lounge located in the basement of Avery Hall. The lounge is highlighted by a beautiful mural designed by UNL math alum Jenny May with help from graduate student Nick Owad. This lounge was a much-needed space for our undergrad math majors to collaborate, study, hang out or nap! A Q&A with Jenny May can be found on page 7.

Our education reforms, both at the undergraduate and graduate level, continue to receive national recognition and be awarded federal grants. The NSF SEMINAL grant (see page 3) is aimed at helping other institutions make improvements in precalculus and calculus instruction, using successful models developed at UNL, Colorado-Boulder and San Diego State. The UNL team consists of Allan Donsig, Wendy Smith and Nathan Wakefield.

And on the graduate education front, Judy Walker will lead a new project funded by the NSF INCLUDES program (see page 4) aimed at increasing the number of U.S. women earning doctorate degrees in mathematics. As many readers of the newsletter know, our graduate program is nationally recognized for its efforts to foster an environment in which both women and men can succeed at high levels. Judy's investigative team will research ways to enhance these efforts, not only locally, but also on a national scale.

Finally, I want to thank all of our many friends who have supported and continue to support our program. Much of what we do would not be possible without your generosity. Because of your donations, many of our bright undergraduate majors are on scholarships, our graduate students are able to travel to conferences, our outreach programs have adequate support, and our faculty are better able to collaborate and disseminate their research discoveries. If you find yourself on campus and want to stop in Avery and say hello or introduce yourself, please know that you are always welcome. I hope you enjoy this newsletter, and I wish all of you a happy holiday season and New Year.

Stay connected

Tell us more about your career by submitting your Class Notes on our Career Profile survey at http://www.math.unl.edu/friends.

Thank you to our Donors

Chair's Circle
(donors above $5,000)

Mrs. Gwinneth C. Berexa
Ms. Amy S. Bouska
Mr. Richard D. Hitz
Mr. and Mrs. Hans Jeans
Dr. W. James Lewis and Ms. Doris Lewis
Mr. and Mrs. Allan and Diane Lozier
The Lozier Foundation
Omaha Schools Foundation
Mr. Conrad Rennemann, Jr.
Ms. Patricia Winter and Dennis Holsapple, J.D.

Friends

Mr. and Mrs. Mark and Kelly Allison
Mr. and Mrs. James and Joyce Angell
Dr. and Mrs. Jack and Lois Beal
Mrs. and Mr. Cindy and Douglas Beaman
Dr. Monte B. Boisen, Jr., and Helen Reynolds Boisen
Ms. Linda J. Bors
Dr. and Mrs. John E. Boyer, Jr.
Ms. Virginia Brokaw
Miss Frances Buell
Dr. and Mrs. Karl and Nancy Byleen
Mr. and Mrs. Rodney and Susan Chandler
Dr. and Mrs. Thomas and Ruth Clark
Mr. and Mrs. David and Lauralisa Clements
Mrs. and Mr. Kathleen and David Coles
Mr. Joseph E. Collard, Jr. and Mrs. Junilla Collard
Dr. and Mrs. Douglas and Genevieve Dailey
Mr. Thomas Danaher
Mr. and Mrs. Timothy and Lisa Davis
Dr. Gopi Goda
Dr. and Mrs. Gary and Margaret Gruenhage
Mr. Ernest E. Haight
Ms. Rebecca Harbison
Dr. and Mr. Jacqueline and Carl Henningsen
Mr. and Mrs. Tyler and Kaylie Hoehn
Dr. Scott A. Hottovy and Ms. Anna O. Latta
Dr. Baoping Jia and Yu-Ming Jia
Drs. Erica L. Johnson and Howard Skogman
Mrs. and Mr. Susan and Jason Katt
Dr. Brian Kell
Drs. Zoran and Vesna Kilibarda
Mr. Arthur Lapin
Dr. and Mrs. Matthew and Tammy Larson
Dr. Kyungyong Lee
Mr. and Mrs. James and Anita Lipton
Mr. Collin Lysford
Miss Melpi R. Magliveras
Dr. Joseph M. Mahaffy
Drs. Thomas and Katherine Marley
Mr. Richard P. Marshall, Jr. and MaryLiz Marshall
Sen. John McCollister and Deborah McCollister
Drs. John C. and Glory L. Meakin
Mr. and Mrs. Mark and Elizabeth Moisan
Mr. and Mrs. Robert and Rosemary Montgomery
Mr. and Mrs. Edward and Christine Myers
Dr. Ben Nolting
Dr. and Mrs. Glenn and Clara Pfeifer
Ms. Amanda J. Potts
Mr. Donald P. Pribil
Dr. and Mrs. Mohammad and Dawn Rammaha
Mr. and Mrs. Robert and Katherine Riggins
Sen. James Scheer and Mrs. Kristi Scheer
Dr. Robert Schwabauer
Dr. and Mrs. Steven E. and Clista K. Seals
Dr. Alexandra Seceleanu
Drs. David and Muriel Skoug
Ms. Mary Sommermeyer and Dr. Earl Kramer
Mr. Bartholomew Z. Stephens and Ms. Christina F. Sposato
Mr. and Mrs. Travis and Angela Stiens
Mrs. and Mr. Sharon and Conrad Sturch
Dr. and Mrs. Melvin and Rosemary Thornton
Dr. Kenneth Tolo
Dr. and Mrs. Daniel and Jennifer Van Peursem
Mrs. and Mr. Mary and Douglas Wadman
Drs. Judy L. and Mark E. Walker
Mr. and Mrs. Dean M. and Teresa A. Way
Mr. Matthew J. Wiedel
Drs. Roger A. and Sylvia M. Wiegand
Mr. Adam Wigington

Contributions to the math department funds can be made at **http://www.math.unl.edu/department/giving** or through the mail (see page 20 for donation form). Thank you for supporting the Nebraska Department of Mathematics.

T-shirt Travels

Amy Bouska (BS '69) wore her Nebraska mathematics shirt to Portugal in 2015

Send us your photos from your vacations (wearing either your Mathematics shirt or any Nebraska Huskers shirt!) to: nebraskamath@unl.edu

MEAKIN *From Page 10*

The Living Experience

My wife and I were housed in a serviced apartment on the XJTU campus, about a 10-minute walk from my office in the math department. The apartment was modest but comfortable and everything we needed was readily available. We were a few minutes away from supermarkets, restaurants, shops, street markets and transportation to the city center (about 6-7 kilometers from the XJTU campus). Xi'an is a second tier city by Chinese standards, but large by U.S. standards, with a population of around 8 million people (closer to 15 million if surrounding areas are included). There are over 70 universities in the city of Xi'an, many of them with brand new branch campuses situated in the outer suburbs of the city. The central part of the city is enclosed by a rather spectacular medieval city wall and many people, myself included, rent bicycles to ride the 14 kilometers along the city wall around the old part of the city (see photo). The city is the ancient capital of China, the entry point to China of the silk road that linked China and Europe in the days of Marco Polo, and the site of the relatively recently unearthed terra cotta warriors constructed during the Qin dynasty over 2,000 years ago. It has a colorful, touristic, Muslim quarter filled with exotic foods and a wide variety of items to buy. The city has been continuously inhabited for around 6,000 years. It is a major tourist attraction in China, and hosts many thousands of visitors each year.

On the occasions when I gave a talk at another university across the city or when we ventured out of the confines of the XJTU campus to explore some of the museums and tourist sites around Xi'an, we got a glimpse of some of the modern day problems of traffic congestion and urban sprawl that choke the city (and many other large cities). China is developing at an incredibly rapid pace, and much of Xi'an, outside the ancient central part of the city, is totally transformed from what it was when Glory and I were last here in 2007. There are many hundreds, probably

COURTESY PHOTO

John Meakin rides around the city wall in Xi'an, China.

thousands, of new high-rise apartment complexes springing up all over the city, each housing well over 1,000 people. The infrastructure is vastly improved from what it was nine years earlier, the city is much cleaner, there are many more restaurants and high end shopping outlets, a well developed public bus system, and work is rapidly progressing on new subway lines. There are times, particularly during the winter I am told, when the air quality is poor, but for the most part this was not a problem for us.

Despite all this development, the city retains much of its traditional character and charm. We spent most of our time on and around the XJTU campus, dining in small local restaurants, shopping in local markets or street stalls, and exploring the neighborhood around campus. Virtually all of the faculty, staff and students at XJTU live on campus or else very close to campus, and there is a real sense of a coherent and vibrant academic community. There is a school for young children on campus and a university-affiliated elementary school and high school very close to campus. It is common to see grandparents picking up their grandchildren from school or walking across campus, young children in tow, mingling with university students, faculty and staff. The campus is quite pleasant, with many streets lined with tall sycamore trees that form a cathedral like canopy across much of the campus. The changes in class time are marked by pleasant music rather than shrill bells, and there is often music piped across campus at various times between classes and in the evenings. There are security guards at all entrances to the campus and electronic monitoring of people and vehicles across campus.

We found people to be very friendly and helpful, despite a rather serious language barrier that we had to deal with. We picked up some rudimentary mandarin language in a few classes that we managed to attend through the Confucius Institute before we traveled to China, but we were often at a loss to communicate adequately, and we were unable to read more than a handful of Chinese characters. While most of the students and faculty could understand English at some level, few of them speak it well, and even fewer people off campus have any understanding of the language. Of course in the central part of the city and at the main tourist sites, there are English speaking guides, but for the most part we found very few people who could understand any language other than mandarin and their local Chinese dialect. We were able to listen to English language programming through one of the government-run CCTV channels but had no access to foreign television or radio programming other than the National Geographic channel. We had good Internet access but no access to Google or facebook or most other Western social media sites.

We had a few opportunities to travel around China, on long weekends and during a weeklong national holiday early in October. I gave talks at four different universities in Xi'an and in Guangzhou, Hong Kong and Suzhou. We also managed a weekend trip to see some of the spectacular paintings and sculptures in the Buddhist caves of Mogao near Dun Huang, an important city on the silk road on the edge of the Taklamakan desert in northwest China, and another trip to Lijiang, a beautiful tourist city near the border with Tibet. We are planning brief visits to Guilin and Shanghai at the end of our stay in China. All in all, we spent an interesting semester in China.

– John Meakin, emeritus professor

Hard work resides in teaching

Good teaching matters.

Nowhere did that become more apparent to Johnny Henderson than as a doctoral student at Nebraska.

"I was exposed to exceptional teachers throughout my four years at UNL," said Henderson, who has been a distinguished professor of mathematics at Baylor University in Waco, Texas, since 2002. "As a graduate student, good teaching and effective teaching had become as important to me as my course studies and research. I had a good feeling that UNL had adequately prepared me to begin making contributions along those avenues. My adviser, Lloyd Jackson, was not a person of many words, but every word carried weight and told the story" (see online version of this story to read more anecdotes from Henderson about Nebraska math professors).

In April of 2016, Henderson was awarded the Cornelia Marschall Smith Professor of the Year Award from Baylor. The Cornelia Marschall Smith Award is presented to a faculty member who makes a superlative contribution to the learning environment at Baylor, including teaching which is judged to be of the highest order of intellectual acumen and pedagogical effectiveness, research which is recognized as outstanding by the national and/or international as well as local community of scholars, and service which is regarded as exemplary in building the character of intellectual community at Baylor.

A member of the inaugural class of Fellows of the American Mathematical Society, Henderson conducts research in the areas of boundary value problems for ordinary differential equations, finite difference equations and dynamic equations on time scales. He is a prolific scholar who has close to 500 publications in mathematical journals, putting him in the top 1 percent of scholarly productivity for all mathematicians in the world, and his work has been cited nearly 3,700 times.

Johnny Henderson

Henderson said he has Jackson to thank for helping him secure offers from great universities after earning his Ph.D. from Nebraska in 1981. Before arriving at Baylor, Henderson also taught at the University of Missouri at Rolla and Auburn University, where he was promoted to full professor and was an endowed chair.

"At each university where I have served, I have received some type of recognition for teaching," said Henderson, who has also held visiting research fellowships at Tamkang University in Taiwan, the University of Queensland and the University of New South Wales in Australia, and spent one year as a Visiting Research Scientist at Georgia Tech. "Teaching is where the hard work resides."

Henderson, who grew up in the small farming town of Newark, Arkansas, developed a strong interest in mechanical drawing and drafting during high school. After graduation, he was admitted to the University of Arkansas, and considered majoring in engineering, but did not, due to a recession. He also considered architecture, but "that was a five-year degree curriculum – and who wanted to go to college for that long? So I enrolled as a math major, with the idea of changing majors if something else moved me."

After completing his bachelor's degree at Arkansas, math continued to be the only force moving his career path along. Henderson started graduate school in mathematics at Arkansas and found he not only enjoyed teaching, but also realized it can make an immediate positive impact on students' lives. While teaching math as an instructor at a four-year college, Henderson began to consider going back to graduate school.

"I would sometimes visit the library and thumb through one of the few mathematics journals there and wonder how a person did the original research in those articles," Henderson said. "I decided to attempt doctoral study in mathematics. I knew it would be a difficult journey, and I had no feel for its outcome."

He applied and was offered assistantships to several graduate schools, and narrowed down his decision to Nebraska and Syracuse. A phone call from chair David Skoug increasing the stipend if Henderson agreed to teaching assignments of six hours per semester sealed the deal.

"The decision was made in taking the bitter winter winds of Nebraska over the deep snows of Syracuse," Henderson added. Fittingly, the "big problem" for his disseration broke one day while he was sitting at a table in the park, "holding my paper down against a strong Nebraska wind."

He and his wife, Darlene, were married soon after high school, and had a daughter, Kathy, during his sophomore year at Arkansas – "the three of us experienced much of this journey together," he said. Darlene and Kathy both earned degrees from Auburn, and Kathy now teaches high school in the Huntsville, Alabama, area. Sadly, one of Henderson's three grandchildren, Katie, was lost in a tornado tragedy in 2007. His Baylor faculty webpage pays tribute to her.

"There are rarely shortcuts in maintaining quality teaching and research programs," Henderson said. "If one strives to serve their students, their department and the profession, the rewards can be exhilarating."

– Lindsay Augustyn, with contributions from Lori Fogleman, Baylor University

Marshall takes road less traveled

When retired lawyer Dick Marshall was once challenging an engineer's work during a deposition, the engineer held fast to his conclusions, notwithstanding his methodology was flawed, and referred to his numbers as "fuzzy math."

"There is no fuzzy in math, just like 'there's no crying in baseball!' " said Marshall, a 1974 graduate in mathematics from Nebraska. "While my duty and loyalty was always to my client, I was able to recognize that when the numbers don't add up, so to speak, you ought to admit it."

Marshall also has accepted that he is a poster advertisement for succeeding in math in spite of yourself. During his time at UNL, the Lincoln native planned his own curriculum, did not interact with math department faculty very much and did not live on campus.

"Truth be told, today I would not recommend the path I took over 40 years ago," Marshall said. "Math always came easy for me, and I likely did not realize how much more I could have learned had I known then what I know now. In today's world, it takes a village, and interaction with faculty and the department is critical. I saw that firsthand during my recent visit and tour of the math department facilities."

Marshall spent 32 years at an oil and gas law firm in Austin, Texas, representing upstream oil and gas producers who lease land and drill wells in search of oil or gas, before retiring in 2011. His work was primarily in the state regulatory arena before the Railroad Commission of Texas, collaborating with geologists, geophysicists and engineers.

His background in math gave him a smooth transition into understanding and critiquing the work of his clients' experts, as well as cross-examining opposing experts.

"It was rare that I was not able to follow an expert's work or opinions and formulate my questions," Marshall said. "The oil and gas business is by nature very competitive."

COURTESY PHOTO OF DICK MARSHALL

Marshall started at UNL as a civil engineering major, switched to electrical engineering, and then found his true passion to be math and physics. As a mathematics major, his favorite courses were linear algebra, advanced calculus and statistics and probability. His courses in philosophy also helped lay the groundwork for choosing to attend law school.

"Look at any path you decide to take in college and beyond – you will find that a math background is by far and away the top discipline for eventual success," Marshall said. "I believe that the elements of logic, which I honed in my philosophy studies, are critical to the study of law, and English composition is also a valuable tool for the study of law. Couple those with a math background, and you have a good head start in law school."

Never underestimate grammar, Marshall added. One of more irritating trends he saw toward the end of his practice was the failure of opposing lawyers to have a grasp on proper grammar. Despite his personal feelings that is he not the best writer, Marshall was the editor-in-chief of the law review at Creighton University his final year in law school and was able to bring the publication up to date.

Marshall said he has learned over the years that hard work and perseverance can overcome long odds. He and his wife, Liz, have been married for 47 years and met in junior high. Their 36-year-old daughter was born with Cystic Fibrosis, and her fight against the disease has been an inspiration to them. Avid motorcyclists, Dick and Liz travel across the country on his Harley Davidson touring bike; in 2002, they rode the entire length of the Lewis and Clark Trail from St. Charles, Missouri, to Seaside, Oregon.

"I attribute much of my success in law school and beyond to a road less traveled by most law students," Marshall said. "I spent two years after undergrad driving trucks, including a year driving an 18-wheeler over the road. People skills are critical and life lessons learned by working in the real world often yield enormous dividends. With a math degree, you can chart virtually any path that interests you and your odds of success will better because of it."

– Lindsay Augustyn

Number of majors in math increases by 32% in five years

For the second straight year, enrollment at the University of Nebraska-Lincoln has surged to a new all-time high. The number of majors in the Department of Mathematics also has increased by 32 percent in the past five years.

"Jobs in today's world require abstract thinking, quantitative reasoning and handling large amounts of data, all skills that you get from majoring in mathematics," said Tom Marley, department chair in mathematics. "It's in the consciousness of students now that math can get you in more doors for employment prospects."

The university announced Sept. 7 that fall 2016 enrollment is 25,897 students, surpassing the previous enrollment record of 25,260 students that was set last year. The 2.5 percent increase from 2015 is the fourth straight year of enrollment growth and the biggest single-year jump in the number of students since 2007. The university is also enjoying the most diverse student body in its history this autumn.

The largest incoming freshman class in the university's history drove the record enrollment. There are 4,860 first-time freshmen on campus this fall, surpassing 1979's entering class of 4,702.

The mathematics department has worked diligently in recent years to increase the visibility of its undergraduate activities and, as a result, attendance has grown, and the atmosphere has been more "active and vibrant," added Marley.

"I am involved in multiple courses of study at UNL, and I've noticed that the math department has a greater sense of community than almost any other. Not only is this one of the most welcoming and active departments on campus, everyone there is so excited about math that it's practically impossible to avoid the contagion," said Shannyn Bird, a sophomore mathematics and biochemistry major. "Rather than absorbing themselves solely with homework and teaching duties, students and professors in the math department are nearly always willing to donate free time toward helping each other with difficult problems or general college advice. Even though this department is not substantially smaller than most others at UNL, all the students and teachers seem to know each other better simply because they interact more often."

> *"The math department has a greater sense of community than almost any other."*
>
> – Shannyn Bird, sophomore math and biochemistry major

For senior Mackenzie Martin, double majoring in mathematics and economics has been a perfect fit.

"After a number of economics courses, it became clear that the subject was almost entirely mathematically based. Majoring in math has provided further clarity in understanding and applying economic principles," Martin said. "I majored in math not only because I enjoy the subject, but also because the degree is versatile, and there is no lack of demand in the job market."

While Martin has decided to go to graduate school in math education at Nebraska, she found in her career search that there is ample opportunity in the industry, academic and government sectors for math majors.

"UNL has done a wonderful job providing practical mathematical application classes, including Operational Research and Math in the City, to demonstrate the importance of mathematics to efficiently address industrial and societal issues. I am confident that the math undergraduate degree would be successful in any field," Martin said.

Through classes such as Math in the City and events held by Math Club, there are ample occasions for companies to recruit math students.

"Businesses are coming to Avery Hall and approaching us about opportunities for our students," said Petronela Radu, assistant professor and undergraduate adviser for mathematics. "Our community is strong, and we have high-quality students."

Colleges leading in the enrollment growth included the College of Arts and Sciences, the College of Business Administration and the College of Agricultural Sciences and Natural Resources.

In the past decade, the university's overall enrollment has grown by 12.7 percent.

Other highlights from the official 2016 census include:

- In addition to its large size, Nebraska's new first-year class maintains a strong academic profile. Its average ACT score was 25.2, identical to last year's and slightly below the all-time high of 25.4 in 2014.
- Enrollment of 2,980 minority undergraduate students – 14.3 percent of the undergraduate total – makes this fall's undergraduate student body the most diverse in the university's history. Minority students make up more than 17 percent of this year's freshman class.
- In-state students' interest in the university continues. This fall, there were 3,500 first-time resident freshmen, a roughly 1 percent increase in that category from 2015.

– Lindsay Augustyn and Steve Smith, University Communication

Musgrave earns NPSC fellowship

Graduate student Erica Musgrave is the recipient of a National Physical Science Consortium (NPSC) Graduate Fellowship.

The NPSC is a partnership between government agencies and laboratories, industry and higher education. NPSC's goal is to increase the number of American citizens with graduate degrees in the physical sciences and related engineering fields, emphasizing recruitment of a diverse applicant pool.

Applications are sent to national labs and government agencies for sponsorships. The Department of Defense chose to sponsor Musgrave for six years. She will do an internship with them during one of the summers while she is in graduate school.

Musgrave, a native of Lodi, California, attended Saint Mary's College of California and is in her first year of graduate school at UNL.

The NPSC Graduate Fellowship provides an annual $20,000 expense allowance, lasting for up to six years, bringing total funding to as much as $120,000. The fellowship covers full tuition and required fees, allows a research or teaching assistantship, includes one or two paid summer internships with a government agency, provides a mentor and, therefore, establishes a lasting relationship with the sponsor.

Erica Musgrave

"When I found out I was selected for the NPSC fellowship, I was shocked," Musgrave said. "I was also ecstatic and very flattered that the organization thought I was worthy of being funded."

Since inception in 1989, NPSC has awarded 503 graduate fellowships. Of those fellows, 82 percent have been minority, female, or both, those historically underrepresented in science. Recent alumni have received Ph.Ds. from Caltech, Cornell, Duke, George Washington, North Carolina State, Stanford, Texas A&M, UC Berkeley, University of Chicago, University of Illinois, University of Maryland–CP, University of Michigan, University of Missouri, and University of Wisconsin.

Pitts lands Fulbright in Germany

Helen Pitts works as a graduate teaching assistant at the University of Nebraska-Lincoln, teaching introductory German to students. However, this fall she switched gears and continents, as she was awarded the position of English Teaching Assistant in Germany by the Fulbright Program.

Having graduated from UNL with majors in German and mathematics, Pitts is now working toward a master's degree in German and foreign language pedagogy at UNL. In addition to her graduate teaching assistantship, she has gained teaching experience as a past organizer of UNL's All Girls/All Math summer camp. She plans to use the skills she learned in these roles to effectively teach and build relationships with her English-language students in Germany.

To reach her future students, Pitts said she will also harness her own background in creative writing.

Helen Pitts

"Students often feel more invested in creative work, so I would like to use prose and poetry to engage students with the English language," Pitts said.

Pitts is not new to Germany or its culture, studying abroad through the Deutsch in Deutschland Institute in 2013. During that time, she worked as an intern for the U.S. Embassy to Germany in Berlin and developed a deep respect for the country's history and literature. As a teaching assistant, Pitts said she hopes to gain a deeper understanding of German culture.

Degrees

2016 Doctorates

Dailey, Douglas *Rigidity of the Frobenius, Matlis Reflexivity, and Minimal Flat Resolutions,* Tom Marley

Edholm, Christina *Management of Diaprepes Root Weevils through Control Theory,* Richard Rebarber and Brigitte Tenhumberg

Egg, Becky *Cohen-Macaulay Dimension for Coherent Rings,* Tom Marley

Lutz, Jason *Homological Characterizations of Quasi-Complete Intersections,* Luchezar Avramov

Muhammad, Inam *Adian Inverse Semigroups,* Mark Brittenham and John Meakin

Owad, Nick *Bridge Spectra of Cables of 2-bridge Knots*, Mark Brittenham and Susan Hermiller

Parmelee, Caitlyn *Applications of Discrete Mathematics for Understanding Dynamics of Synapses and Networks in Neuroscience*, Carina Curto and Jamie Radcliffe

St. Goar, Julia *A Caputo Boundary Value Problem in Nabla Fractional Calculus*, Allan Peterson

Thompson, Peder *Stable Local Cohomology and Cosupport*, Mark Walker

Master's degrees

2016 (MS): Juliana Bukoski, Andrew Conner, Benjamin Drabkin, Elizabeth Galvin, Sean Gravelle, Karina Kelly Uhing, David McMorris, Morgan Swaidan, Katherine Tucker, Marla Williams

2016 (MAT): Drew Adams, Staci Applegarth, Claire Aylward, Brent Barbour, Rachel Birtles, Kristi Briggs, Deb Bulin, Kristin Burt, Jacob Cathey, Melinda Dhoritey, Sherri Doll, Rosanne Entzminger, Rebecca Evans, Kara Fauber, Anna Fischer, Chad Geiger, Michelle Gibbs, Jared Good, Allison Gregg, Jasmine Hansen, Nicole Harris, Michael Hart, Craig Hendrix, Jessica Hoffmann, Aleah Holden, Mark Holland,

See DEGREES *on Page 19*

DEGREES *From Page 18*

Karen Humphrey, Lauren Kasson, Katie Kimball, Dianna Knight, Cole Kohout, Hannah Leitt, Amber Liljedahl, Michael Masin, Douglass Matulka, Joanne Maurer, Megan McElfresh, Todd McQuistan, Philip Medeiros, Traci Miller, Jonathan Northouse, Cailen O'Shea, Tracy Owens, Katherine Poehling, Anessa Price, Breanna Prochnow, Mary Quandt, Lindsey Roorda, Terri Sanchez, Karrie Seibel, Kati Stauffer, Kristin Strader, Alyssa Straube, Ashley Struebing, Kerry Stull, Eryn Surprenant, Jared Wadell, Chelsie Weinandt, Courtney Wichman, Kirsten Wieman, Jason Wunderlich

2015 (MAT): Wade Anderson, Sondra Bravo, James Cattau, Ty Copsey, Donnita Coulter, Margaret Douglas, Thomas Gamble, Hannah Holguin, Richard Kammandel, Jr., Mariel Kloppenborg, Patricia Krause, Lindsay Larsen, Tracy Larson, Kristy Lee, Dawn McKain, Kenzi Medeiros, Molly Mertz, Karen Mohrbutter, Jennifer Olsen, Heather Osborne, Lee Plath, Julie Preston, Amy Smith, Amy Swartzendruber, Heather Waddell, Virginia Yuhas

2015 (MS): Allison Beemer

Bachelor's degrees

December 2015: Gregory Atkin, Thomas Blanton, Po Yu Chen, Marsh Lemen, Elliot Marr, Timothy Mastny, William O'Malley, Steven Schindler, Emma Schneider, Branden Smith, Qixiong Sun, Ian Thackray

May 2016: Audrey Ackerman, Samuel Adams, James Albright, Brittany Bard, Aaron Calderon, Michaela Cunningham, Nathan DeMaria, Qianlun Ding, Ryan Erdmann, Taylor Fish, Thomas Glaser, Steven Gour, Emily Griffin, Megan Han, Ran Jin, Nirmal K C, James Keeler, Kyle Kelley, Seth Kurfman, Shannen Lambdin, Matthew Leech, James Maciag, Mitchell Matis, Jordan O'Neal, Paul Quint, Timothy Rolling, Karen Sanchez Ariza, Claire Schirle, Nathan Schlautman, Christian Spaccarotella, Xiang Teng, Jonathan Wang, Chad Wright, Zijiao Xia, Jiawei Yu

August 2016: Alan Akil, Michael Grantham, Kaylee Homolka, Kevin La, Christian Spaccarotella, Shunya Nogi

Undergraduate Awards

Chair's Prize *Awarded to an outstanding senior mathematics major*
Aaron Calderon

Special Scholarships Awards
Note: 35 scholarships were awarded for the 2015-16 academic year.

Dean H and Floreen G Eastman Memorial Scholars
(for Nebraska high school graduates)
Cashous Bortner, John Chrostek, Shimin Deng, Grace Dickes, Roman Haynatzki, Alexandra Janvrin, Avi Knecht, Terran Merriman-Honerkamp, Jared Ott, Tanner Pfeiffer, Michael Pieper, Ethan Romery, Lawrence Seminario-Romero, Olivia Thiel, An Tran, Elizabeth Tyler, Elizabeth Vandergriend, Collin Victor, Zach Warneke, Brady Wilkerson, Xuehua Zhong

Irwin Dubinsky Memorial Scholars
Hangquan Qian, Veronica Telega

Senior Honors Thesis and Graduated with Distinction *(directed by)*:
Samuel Adams (Computer Science and Engineering, Cottingham), Aaron Calderon (Math, Hermiller, Susse), Emily Griffin (English, Capuano), Mitchell Matis (Biology, Brassil), Jordan O'Neal (Physics, Fuchs), Timothy Rolling (CSE), Claire Schirle (Meteorology, Bathke)

Joel Stebbins Fund Scholarship
Matthew Dunn

Putnam Participants
Aaron Calderon, Shuchen Cao, Thomas Fryklind, Caprianna Keller, Daniel Kelsall, Jordan O'Neal, Michael Purcell, Zachary Warneke, Xuehua (Diana) Zhong

Renneman/Luebbers Scholarship
Austin Buchanan, Claire Tunakan

Drusilla Winchester Scholarship
Samuel Carrasco, Christiana Spicer

Ruby Matzke Wittemore Scholarship
Yi Xie

Dr. Hubert Schneider Scholarship
Yuance He

Sylvia and Hans Jeans Mathematics Scholarship
Erik Eitzman, Henry Recker

Chancellor's Scholars
Gregory Atkin, Nathan DeMaria, Ryan Erdmann

Superior Scholars
Samuel Adams, Aaron Calderon, Michaela Cunningham, Megan Han, Mitchell Matis, Jordan O'Neal, Nathan Schlautman

Graduate Program Awards & Fellowships

Chancellors Fellowship
Gary DeClerk

National Physical Science Consortium Graduate Fellowship
Erica Musgrave

Don Miller Award for Outstanding Teaching by a Graduate Student
John Myers

Steven Haataja Award for Outstanding Exposition
Lara Ismert

Grace Chisholm Young and William Henry Young Award
Allison Beemer and Matt Mills

Outstanding Qualifying Exam
Robert Huben

Walter Mientka Teaching Award
Jessica De Silva

Outstanding First-Year Student Award
Vince Longo

Bill Leavitt Award
Josh Pollitz

Lloyd Jackson Award
Katie Tucker

Emeritus Faculty Fellowship
Derek DeSantis, Carolyn Mayer

Othmer Graduate Fellowship
Robert Huben

GAANN Fellowships
Jessalyn Bolkema, Seth Lindokken

University of Nebraska Lincoln
DEPARTMENT OF MATHEMATICS

203 Avery Hall
Lincoln, NE 68588-0130

Campaign Code: 1LA&S16-MATH

I want to support the UNL Department of Mathematics.

Name _____

Address _____

City _____ **State** _____ **ZIP** _____ **Country** _____

E-mail _____ **Phone** _____

☐ **Enclosed is my check for $**_____. **Please make check payable to the University of Nebraska Foundation.**

☐ **Please charge $**_____ **to my:** ☐ **Visa** ☐ **Mastercard** ☐ **Discover** ☐ **American Express**

_____

Card Number **Exp. Date** **Signature**

☐ **I would like my gift to support the Mathematics Department Fund.** This is an expendable fund that is used to support department priorities such as faculty and student professional travel and outreach activities.

☐ **I would like my gift to support the Math Teachers for the 21st Century Expendable Fund.** This is an expendable fund used for tuition fellowships for Nebraska mathematics teachers (K-12) for graduate courses.

☐ **I would like my gift to support a more specialized fund.** I would prefer that Professor Tom Marley contact me about contributing to an existing fund or creating a new fund for a specific purpose.

Please mail your contribution to: University of Nebraska Foundation, 1010 Lincoln Mall, Suite 300, Lincoln, NE 68508

Math News is a newsletter published for the UNL Department of Mathematics community. To receive Math News via email, please register online. Comments regarding newsletter content should be sent to Tom Marley (tmarley1@unl.edu), Chair, UNL Department of Mathematics, 203 Avery Hall, Lincoln, NE, 68588-0130.

Math News is produced and edited by Lindsay Augustyn of the UNL Center for Science, Mathematics and Computer Education.

@UNLMathematics