The past year in the MSU Department of Mathematics has been a productive and busy one. The first piece of news that I’d like to share with you is that, after serving for seven years as department chair, I am taking a three-year leave of absence from MSU to accept a position as head of the mathematics department at Hong Kong University of Science and Technology (HKUST). In addition to having the opportunity to build research programs there, I am also hoping to create collaborative research opportunities between Michigan State and HKUST. This is an exciting and timely move for me, as I’ve wanted to return to Asia to be closer to family and friends.

I am leaving the department in the very capable hands of Keith Promislow, who will take over as the new chair this fall. Keith has been with us for more than a decade and has been very involved in the teaching and scholarship activities of the department. He is committed to maintaining and advancing our focus on excellence—both in educating our students and in producing world-class research—and I’m confident that the department will continue to thrive and grow under his leadership. Please join me in wishing Keith the best in his new role!

That said, I’d like to briefly touch on a few of the exciting department developments and activities that make us one of the top mathematics departments in the country.

"I am happy to report that our first crop of Advanced Track graduates have all been admitted to some of the top graduate programs in the country—Stanford, the University of Minnesota and the University of Washington.”

With the university making strong pushes on research in big data, the mathematics department is uniquely positioned to take a leadership role. Several of our faculty members, particularly professor Andrew Christlieb, are among those leading the charge at Michigan State to establish a high-profile research program in this area. We’ll report back to you with more details as this important initiative rolls out.

Our faculty members continue to distinguish themselves, landing a number of prestigious awards and honors this past year (see page 3). Among them is assistant professor Aaron Levin, who was awarded a National Science Foundation Early Career Development grant. Aaron’s receipt of this honor brings the total CAREER awards in the mathematics department to seven in the past five years, just under half of the total number of CAREER awards in the College of Natural Science.

Also in this newsletter, you’ll read about some of the outstanding science that our researchers are producing.

In closing, we continue to be most grateful to the alumni and friends who have been central in making a difference through their many gifts and donations to the department; your generosity plays a tremendous role in the success of our graduates.

Yang Wang, Ph.D.
Chair
Department of Mathematics

WWW.MATH.MSU.EDU
Francis Moss, mathematics, ’54, retired since 1991, regularly attends concerts and programs at MSU. He and his wife, Irma, helped out this past school year in the pre-kindergarten class at Donley Elementary School in East Lansing, Mich.

Neil Larks, mathematics, ’59, is a survivor—he’s beaten colon and prostate cancer, and lives with atrial fibrillation and avascular necrosis of the hip. His most difficult challenge these days is learning to correctly pronounce the names of his doctors and his medications!

Jeff Hack, mathematics, ’63, is a retired software engineer from TRW; now Northrop Grumman.

Conrad Fjetland, mathematics, ’64; M.S., resource development, ’73, served for three years as an officer in the Navy. He then returned to MSU for a master’s degree in resource development. A 30-year career in the U.S. Fish and Wildlife Service was followed by a law degree from Arizona State University in 2000. He retired again in May 2013 as a prosecutor in San Marcos, Texas. He and his wife are now enjoying the lakes of Minnesota.

Gary Bond, mathematics, ’66, retired from the Indiana University-Purdue University Indianapolis Psychology Department as Chancellor’s Professor in 2009 after serving 26 years on the faculty. For the past five years, he has been a professor of psychiatry at Dartmouth College in Hanover, N.H.

Diana Bell, mathematics, ’73, was elected in April as board president for the Girl Scouts of Northern California (GSNORCAL). An accomplished businesswoman, a civic and community leader in the San Francisco Bay Area, she also serves as a director on the State of California’s Board of Accountancy and the Sutter East Bay Hospitals’ Regional Board.

Steve Wagner, mathematics, ’73, retired this year from CNA Financial Corporation in Chicago, Ill. He is now living in Alpena, Mich.

David Manderscheid, mathematics, ’76, joined The Ohio State University in July of 2013 as executive dean of the College of Arts and Sciences and vice provost for Arts and Sciences. He is also a professor in the Department of Mathematics. He was elected as a fellow of the American Association for the Advancement of Science in 2013 and of the American Mathematical Society in 2012.

Frank Sottile, physics and mathematics, ’85, is a member of the inaugural class of fellows of the American Mathematical Society, which was announced in November 2012.

Greg Buzzard, music and computer science, ’89; M.S., mathematics, ’91, was appointed head of the Department of Mathematics at Purdue University in West Lafayette, Ind., in the summer of 2013.

Thomas Bellsky, mathematics, ’03, Ph.D., mathematics, ’11, has accepted a tenure-track assistant professor position in mathematics at the University of Maine.

Weihua Geng, M.S., industrial mathematics, ’03; M.S., statistics, ’06, Ph.D., applied mathematics, ’08, was hired by Southern Methodist University, Dallas, Texas, as an assistant professor in the fall of 2013.

Mathew Fukuzawa, mathematics, ’05, graduated with distinction from the Naval Postgraduate School in Monterey, Calif., June 2014, with an M.S. in applied mathematics. He was also awarded the Warren Randolph Church Award for excellence in mathematics. His next position will be as a rotating military faculty member of the mathematical sciences department at the United States Military Academy (USMA), West Point, N.Y., beginning in July.

Jacob Geyer, mathematics, ’05, with a specialization in actuarial science, recently completed his CPCU (Chartered Property Casualty Underwriter) and was promoted to managing director, business analytics and underwriting operations at Accident Fund Insurance Company of America in Lansing, Mich.

Scott Pelak, mathematics, ’08; M.S. mathematics, ’08, is a web developer on the Salesforce.com platform. Additionally, he is a certified salesforce developer.

Elizabeth Carter, mathematics, ’09; M.S., industrial mathematics, ’13, is a senior staff game designer at WMS Industries in Chicago, Ill.

Steven Roy, mathematics, ’10, is currently finishing his master’s degree in statistics at MSU. He works full-time as a predictive modeler at Accident Fund Insurance Company of America in Lansing, Mich.

STAY CONNECTED. Recently started a new job, moved or received an award? Submit your news via bit.ly/cnsalumni and we’ll share it with students and alumni.

Contact Us

The Department of Mathematics newsletter is published annually by the College of Natural Science for alumni and friends.

Copyright 2014 Michigan State University. MSU is an affirmative-action, equal opportunity employer.

Send correspondence to:
MSU College of Natural Science
288 Farm Lane, Room 5
East Lansing, MI 48824

(517) 432-4561 | natsci4you@msu.edu

Contributing writers: Jane L. DePriest, Val Osowski, Laura Selvey and Yang Wang

Photographs courtesy of: Harley Selvey.
Aaron Levin, MSU assistant professor of mathematics, will use a prestigious and competitive award for junior researchers to focus his research on number theory, specifically Diophantine equations.

As the recipient of the National Science Foundation's Early Career Development grant, also called the CAREER Award, Levin will use the five-year, $401,725 award to study interrelated problems revolving around the study of integral points of varieties. The grant also includes an education component, which Levin will use to further undergraduate research projects.

“I have a strong personal connection with undergraduate research that goes back to my freshman year in college and eventually led to my first published papers,” Levin said. “I am excited that this grant will give me an opportunity to further cultivate the potential of talented undergraduates at MSU and further an area of research that interests me.”

CAREER awards recognize promising faculty in the early stages of their careers who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research. Levin, who came to MSU in 2010, received his Ph.D. from the University of California, Berkeley.

Three members of the mathematics department were honored Feb. 1 at the 2014 MSU Awards Convocation, which recognizes outstanding contributions to education and research by MSU faculty and staff members:

- Richard Hensh, senior academic specialist of mathematics and assistant to the department chair, received the Distinguished Academic Staff Award. Hensh has always focused on student development and has worked with the emerging scholars program, an enrichment program to help students transition from high school to university-level mathematics.

- Teena Gerhardt and Benjamin Schmidt, both assistant professors in mathematics, received Teacher-Scholar Awards. Gerhardt's teaching experiences range from business calculus to graduate-level algebraic topology. She is dedicated to making mathematics exciting and approachable to diverse groups of students. Schmidt's teaching incorporates an enthusiastic lecture style that engages students. One of his goals is to present math as a lively and colorful subject, full of open problems that remain unsolved.

In addition, Peiru Wu, director of MSU's Professional Science Master's in Industrial Mathematics, received the Board of Directors Award from the National Professional Science Master's Association at the group's national conference in November 2013. Wu served on the board of directors for the organization in 2013.

Fifty years after arriving at MSU as an assistant mathematics professor, Glenda Lappan, University Distinguished Professor of mathematics at MSU, and co-author of the Connected Mathematics Project (CMP) middle school mathematics curriculum, has retired from MSU. Her perseverance and dedication over the years as a mathematics teacher and researcher has transformed the way middle school mathematics is taught today.

After teaching mathematics and math education for several decades, Lappan turned her attention to mathematics curriculum research. Working with MSU colleagues Elizabeth Phillips and the late William Fitzgerald; James Fey from the University of Maryland; and Susan Friel from the University of North Carolina, Chapel Hill, Lappan developed the Connected Mathematics Project (CMP) with funding from the National Science Foundation. The team developed CMP for middle school mathematics because they believed that teaching materials for this group were “woefully inadequate at capturing the imagination of students.”

The third edition of the curriculum, which is now used in all 50 states and several international schools, was published in the fall of 2013.

Lappan was named an MSU University Distinguished Professor in 1998 in recognition of the importance of her work. In 2002, the Lappan-Phillips-Fitzgerald Endowed Chair in Mathematics Education was created in honor of CMP's three MSU founders.

A reception celebrating Lappan's many career accomplishments was held April 25 at MSU's Wharton Center for Performing Arts.
Matthew Hedden, assistant professor of mathematics at MSU, has a passion for knots. While most of us see a knotty problem as... well, a problem... for Hedden, it’s a welcome challenge.

Hedden’s research interest is low-dimensional topology. More specifically, a branch of his research is focused on knot theory—the study of knots in a mathematical sense.

To a mathematician, a knot is a closed piece of string with no loose ends. Or, in mathematical parlance, the “embedding of a circle in three-dimensional Euclidean space.” It is quite unlike the definition of a knot in everyday life, such as in a shoelace or a rope, which has two loose ends.

“One of the things I find fascinating about knot theory is that it connects with a lot of other areas of mathematics... Knots are the building blocks for all three- and four-dimensional shapes,” Hedden said.

“Knots are also relevant from the perspective of trying to find meaningful models of our universe. In fact, some of the most powerful tools for studying knots come out of theoretical physics.

“For instance, if we lived in a pretzel dough universe, and if I were to remove a pretzel-shaped knot, there would be a pretzel-shaped hole there. If I were to replace it, but twist it, and glue it back into the hole, it would be different. This would change the shape of the universe.”

While Hedden is a “pure” mathematician, there are emerging applications for knot theory—such as in biology. For example, the DNA of various bacteria can become “knotted.” In order to replicate, the DNA must “unknot” itself. Specific enzymes, known as topoisomerases, perform the act of “cutting” the string (or circular stand of DNA) and passing it through itself, to accomplish the unknotting. In this case, the complexity of the knots becomes highly relevant. The number of times the string needs to be cut is known as the unknotting number.

Perhaps the most fundamental question about knots is: Is there an algorithm, or is there some way to determine whether or not what appears to be a “knotted up” piece of string is actually an unknot? In a short paper published in 2009, Hedden demonstrated the use of the Khovanov homology theory, which was developed in the late 1990s, to detect an unknot in an algorithmic way.

Unlike number theory or Euclidean geometry, which are of course very old, the field of general topology is fairly new. While there was some work on knot theory in the late 1800s, it didn’t become popular until the second half of the last century. Indeed, Hedden’s particular area of research, low-dimensional topology, became popular even more recently—in the 1970s and 1980s.

“This is typically how new areas of math emerge. Somebody has a great new idea, a great new perspective on something. And in the field of mathematics, there is always a zoo of new ideas and perspectives,” Hedden noted.

“I don’t know any area of mathematics where having some topological intuition isn’t helpful. It’s a framework that is useful for every branch of math,” Hedden added.

Today, topology (along with analysis and algebra) is one of three core areas in most pure math doctoral programs in math departments at universities across the United States.

So, will Hedden ever tire of his research work? Knot a chance! #
Forty-seven years after receiving his bachelor's degree in mathematics from Michigan State University, Ron Simon found himself back in an MSU classroom. But this time, he was not enrolled in MTH 234, or MTH 320 or MTH 421. He registered for 152-Harry Potter and the Secrets of British English, 252-Straw and Tape, 504-Exploring the Forest Community, and 656-History of Sparty—alongside his 11-year-old grandson Alex.

The two attended this year’s Grandparents University, a program designed for alumni and grandchildren (ages 8-12) to come together for a three-day educational experience on the MSU campus.

The now-retired Auto-Owners Insurance Company CEO has always recognized the value of an MSU education. Now, he and his wife, Mary, are giving back to the university that started him down a highly successful career path.

**“Actuarial science is key—and critical—to the insurance industry.”**

Simon began his studies in mathematics at Michigan State in 1963, and also enrolled in all of the computer science courses that MSU offered at the time.

“Although math—and MSU—was challenging, it was one of the things I knew I was going to accomplish. My attitude is: Given a challenge, we can live up to it; we are going to achieve what challenges come to us,” Ron said.

He was married in summer 1966, between his junior and senior year at MSU. While Mary worked full time, Ron took a job at Auto-Owners—full-time that summer, and then part-time through his senior year. After Ron earned his degree in 1967, Auto-Owners offered him a full-time position in the programming area.

“I liked the people, and I liked the company, so I continued on,” he said.

Ron spent the first 23 years in the IT/computer science area at Auto-Owners.

He then moved to and led the actuarial science area, and also acquired all of the underwriting responsibility for the company. He served as treasurer, was named president in 2005 and became CEO of the company in 2008. He retired in 2010 after 44 years of service.

“We always felt we were blessed, so we wanted to give back,” Mary said. “We have a fondness for Michigan State, and Ron has had a great involvement with MSU’s Actuarial Science Program. We thought it was a good place to put some of our resources.”

Together, they established an endowment at MSU to support the Actuarial Science Program; it includes funding for the Ronald H. and Mary E. Simon Actuarial Science Lecture Series, now in its third year.

“Actuarial science is key—and critical—to the insurance industry. When MSU developed the actuarial science emphasis, I felt that it was something I wanted to be involved in,” Ron said.

He added that Auto-Owners continues to hire numerous MSU mathematics / actuarial science graduates.

“It’s important for the university to develop relationships with the business community,” Ron said. “Having strong academic programs, and providing the skills necessary for students to be productive and able to contribute to society—that elevates the academic programs and the business community.”

This year’s Simon Lecture, which takes place on November 7 (see below), will focus on the synergy of the business and academic communities.

In retirement, the Simons continue to contribute to the community through volunteer and philanthropic activities. Ron served on the College of Natural Science Dean’s Advisory Board, and currently serves on MSU’s Actuarial Science Advisory Board. He also chairs the Sparrow Foundation Board, and is involved with the Michigan Dyslexia Institute and Volunteers of America.

Mary works with the Tri-County Office on Aging and delivers Meals on Wheels.

In June, alongside Alex, one of his five grandchildren, this already highly successful grandpa added perhaps the most important academic achievement to his resume—a diploma from MSU’s Grandparents University!
Advanced Track graduates give high marks to program

The Advanced Track Mathematics Program is leaving its mark on its first cohort of graduates. All of them will attend graduate school and are crediting the program with much of their undergraduate success.

“Our program attracts highly talented students, who will make significant contributions to society,” said Jeanne Wald, associate chair of mathematics, who helped develop the program and continues to direct it. “Several of them are already involved in research areas, such as medicine and engineering. They are amazing individuals, often spending hours helping others who may be less gifted. I feel privileged to know them.”

The Advanced Track program offers students a special set of courses that are more intensive than the standard undergraduate math curriculum and challenges them to study mathematics as an experienced mathematician does. It also gives students outreach experience, employment in the Mathematics Learning Center and opportunities to present research at MSU and national conferences.

The Advanced Track students who graduated in 2014 and the universities they will attend for graduate school are: Erik Bates, Stanford University; Dan Diroff, University of Minnesota; Jon Jonker, University of Washington; and Trevor Steil, University of Minnesota.

“Advanced Track helped me to develop close relationships with the best professors in the math department,” said Steil, who is studying math this summer and then moving to Minneapolis for graduate school. “They were able to accurately assess my abilities and help me get into a graduate school that fit with my talents.”

Bates believes that the Advanced Track program helped him to think analytically and creatively, something that is often more pivotal for success in future scientific endeavors.

“This skill is honed in Advanced Track courses, and having quality instructors and similarly motivated classmates are helpful in inspiring its development,” said Bates, who will spend two months this summer working on a project at UCLA as part of the Research in Industrial Projects for Students (RIPS) program before heading to Stanford.

Brandon Albers, who participated in the Advanced Track program and graduated early, has completed a year of graduate school at the University of Wisconsin, Madison.

“I absolutely believe that Advanced Track played a major role in getting me here,” Albers said.

As more students participate in Advanced Track and graduate, the effect will undoubtedly be helpful to the math department’s reputation.

“I believe that as alumni of the program spread, MSU’s Advanced Track will build a reputation for producing well-prepared and highly motivated students,” Bates said. “A tradition of sending students to top-tier graduate schools can blossom with that reputation.”

2+2 dual degree program in actuarial science a bold step for department

MSU President Lou Anna K. Simon has challenged faculty, staff and students to be “Bolder by Design,” an initiative to find ways to meet the challenges of the 21st century. The MSU Department of Mathematics believes that the development of a dual degree program in actuarial science with Guangzhou University in Guangzhou, China, fits the “bolder” criteria.

Under the leadership of Yang Wang, professor and chair of the department, and Albert Cohen, actuarial academic director, the new venture will bring students from the Chinese university to MSU for their third and fourth years of college. Upon graduation, the students will receive degrees from both MSU and Guangzhou University. Moxun Tang, associate professor of mathematics, and Yimin Xiao, professor of statistics and probability, also helped develop the program.

“China has jobs for trained actuaries who work in numerous industries, not just with insurance companies,” Cohen explained. “Hedge funds, sports agencies, lawyers and many different kinds of companies now employ actuaries.”

Students will spend the first two years at Guang Zhou University, developing strong math skills. At MSU, students will focus on actuarial science skills, including the courses needed for all five actuarial exams.

The program will begin in the fall of 2015 with about 10 to 15 students, with plans to expand to 30 to 40 students.

“During the two years students spend here, they will be exposed to the American business climate, the American way of thinking in terms of applying actuarial science practices,” Cohen said.

Wang sees the program as reflecting the department’s and MSU’s growing interest in developing a presence in China.

“We believe this program will definitely help MSU establish a strong presence in an important region of China,” Wang said.

“We want MSU to have a global reputation in actuarial science.”

Department of Mathematics
Where does the study of literary work and math intersect? In the research realm of Yang Wang, department chair and professor of mathematics at Michigan State University.

His research areas include applied harmonic analysis, tiling, fractal geometry and digital signal processing. But one of Wang’s recent projects explored author attribution, specifically, who really wrote President Obama’s autobiography, *Dreams from My Father*. Prolific author William Charles “Bill” Ayers, an American elementary education theorist, claimed he wrote Obama’s book. Wang and MSU graduate student Janice Hu wanted to find out using mathematics.

“*We were able to demonstrate strong stylistic inconsistencies, showing ... that Ayers did not write Obama’s autobiography.*”

Wang’s interest in author attribution began with an earlier study on *Dream of the Red Chamber*, a classic Chinese novel that caused much controversy in Chinese literature. The book, originally circulated as a handwritten copy circa 1760 with only 80 chapters, had 120 chapters in a later-released print version. The question was: Were the added 40 chapters a forgery?

“Modern and rigorous mathematical techniques revealed that the style of the first 80 chapters was inconsistent with the last 40 chapters. This almost definitively shows that the two parts of the work were not written by the same author,” Wang said.

A more recent controversy involved the Pulitzer Prize-winning *To Kill a Mockingbird* by Harper Lee. Many skeptics did not believe that Lee was capable of writing such a masterpiece because she had no previous track record, and she never wrote another book. There was speculation it was written by Truman Capote, a good friend of Lee’s.

“This was debunked by Capote and Lee, but the rumor persisted,” Wang said.

But when mathematics was used to compare the book to Capote’s work, it showed inconsistent styles. “We were able to provide pretty strong—in my mind, irrefutable—evidence,” Wang said, “that Capote did not write *To Kill a Mockingbird*."

To arrive at these authorship attribution conclusions, Wang and Hu applied a technique called “machine learning” to identify unique features for an author. These features could include length of sentences and frequencies of words.

“But you don’t know which features are useful,” Wang said. “Some provide no discerning power, while others are fairly crucial. So you need to find, among all of the features, a subset that truly differentiates one author from another. This is where machine learning comes in.”

With the Obama project, Wang and Hu compared *Dreams from My Father* to known Bill Ayers books and Obama’s other book, *Audacity of Hope*.

The result?

“*We were able to demonstrate strong stylistic inconsistencies, showing—again with almost irrefutable evidence from a mathematical point of view—that Ayers did not write Obama’s autobiography,*” Wang said. “In fact, Obama almost certainly wrote *To Kill a Mockingbird* himself because there is a great deal of stylistic similarity with *Audacity of Hope*, which has no authorship controversy.

“But of course, everything Obama does today is viewed as a conspiracy by some,” Wang joked, “so it wouldn’t surprise me if someone claims to have written the other book.”

Michigan State University
Making sense out of chaos

The economy, weather systems, and birds’ migratory patterns all have something in common, albeit not evident to the casual observer.

That something is chaos—but not in the everyday, casual sense of the word (although when it comes to finances and the weather, some people would argue otherwise).

Chaos exists everywhere, in every field,” said Tien-Yien Li, University Distinguished Professor of mathematics at Michigan State University. He was the first to introduce the word “chaos” in the field of mathematics in a short paper titled “Period Three Implies Chaos.” It has also been said that the paper “turned over a new leaf in the research of chaotic dynamical systems.” Co-written with Jim Yorke, a University of Maryland professor, it was published in The American Mathematical Monthly in 1975.

In the February 2009 issue of Notices of the American Mathematical Society, that paper was described as “one of the immortal gems in the literature of mathematics.” It is one of the most frequently cited papers in mathematics and physics.

The Li-Yorke Theorem thoroughly unveiled the nature and characteristics of chaos: the sensitive dependence on initial conditions and the resulting unpredictable nature of the eventual behavior of the dynamics.

Li explained the phenomenon. “If you start at a certain point, and something behaves a certain way, you would expect it to continue to behave in a certain way,” he said. “But it turns out that is not the case. You can predict the weather within the next five minutes, but not within the next five weeks. Maybe tomorrow’s weather, but even tomorrow’s prediction will not be exactly right.”

Li is also a leader in the field of solving polynomial systems, where his current research focus lies. Solving the roots of polynomial systems appears frequently in the scientific world, such as formula construction, geometric intersection, inverse kinematics and computation of equilibrium. Over the years, Li and his students have obtained a series of outstanding new research results.

Li, who has been teaching in the math department since 1976, describes himself as “an applied mathematician.” Most others call him a “trailblazer.”

Tien-Yien Li, University Distinguished Professor, was the first to introduce the word “chaos” in the field of mathematics.