

Mathematical Sciences

UNIVERSITY OF MONTANA

Spring 2013



New Course Teaches Students About Streaming Data

By Kegan McNeill-Rabil and Brian Steele

In the fall of 2012, the University of Montana premiered a new course in big data analytics entitled *Introduction to Streams*. The aim was to educate students from a variety of areas (mathematics, computer science, and business information systems) in this new and rapidly growing field.

Big data analytics is a collection of mathematical and computational methods for extracting information from streaming data and massively large data sets. *Introduction to Streams* focuses on the more difficult of the two types of data: streaming data. "Streaming data" refers to data that continuously flow across interconnected communication channels. One example might be the data generated by the sensors on a driverless car. Another would be that generated from blood gas monitoring of intensive care patients. In both of these cases, there is not much point in saving data since the information is needed immediately. Conventional statistical methods and theory are of limited use because the fundamental and necessary conditions behind these methods (for instance, the existence of a clearly defined population and sampling method) are absent. A new perspective is needed, free of the old assumptions of random

sampling, independence and the Central Limit Theorem. Data analytics is a new, exciting, and rapidly developing mathematical arena.

People in both science and business are beginning to recognize the potential of streaming data and massively large data sets. By exploiting streaming data, more and better information is gathered, and decisions can be made more quickly resulting in greater efficiency and competitive advantage. Analysts with knowledge of the new area are being fiercely recruited. Governments, particularly in areas related to security, are one source of demand, but companies which can effectively use these data streams have competitive advantages which CEOs are beginning to recognize. Starting salaries for data analysts are high enough to serve to depopulate the math department faculty if it were not the case that many are near retirement.

To deal with streaming, analysts need to be well-

trained, not only in mathematics, but also in computational methods. Because of the multifaceted needs of data analysts, *Introduction to Streams* draws from the disciplines of mathematics, computer science, and business. Indeed, the course has been co-taught by professors from Mathematics and Business. Topics are introduced via examples from business, cyber security, and

See STREAMS COURSE page 2



Professor Brian Steele will teach the course this fall.

Streams Course Cont.

the social media. In the second half of the semester, students begin working in cross-disciplinary teams on solving problems from these areas. A central component of the course is IBM InfoSphere Streams, an IBM computational platform developed for streaming data, and arguably the most sophisticated of the commercial platforms for streaming data analysis.

Like the subject matter, *Introduction to Streams* is evolving. The course began in the fall of 2012, in large part because of Alex Philp, president of GCS Research, who recognized the need for data analysts and understood the professional value to students of having been trained in big data analytics. Philp's support has been indispensable, and he continues to support both the course and the development of a cross-disciplinary minor in data analytics. When asked why he became involved with the course, he said "I felt that the University of Montana needed to start learning about this...we would be doing a disservice to the students of the University if they did not have exposure to a very robust, interesting platform developed as a gateway to this much larger phenomenon of real-time analytics."

In addition to support from within the community and the University, IBM has helped sponsor the course. "I worked with IBM to get them to come and teach a class in this originally two summers ago," said Philp, "and in that way lay the foundation for being able to try to offer a four credit class." IBM has continued to help fund the course as well as supply materials, software and educational resources through their Academic Alliance program with the University of Montana.

In the spring semester, Professor Brian Steele from Mathematical Sciences began co-teaching the course with Eric Tangedahl, Technology Director at the School of Business Administration, and the emphasis shifted more toward analytics. Reflecting this shift, the title of the course has changed to *Real-time Data Analytics*, and Steele and Tangedahl are working hard this summer at seamlessly integrating the mathematical and computational aspects of data analytics. Right now, *Real-time Data Analytics* is the only undergraduate course taught in the world in data analytics and IBM InfoSphere Streams.

Leonid Kalachev Wins International Education Award

By John Bardsley

Our chair, Dr. Leonid Kalachev, has won the 2013 UM Distinguished Service to International Education Award. Dr. Kalachev has been consistently involved in international activities since he arrived at UM nearly 20 years ago.

During that time he has spent faculty exchanges at Toyo University, Japan, University College Cork, Ireland, Moscow State University, Russia (his alma mater), and the University of Helsinki, Finland. However, these exchanges do not tell the whole story. Dr. Kalachev's international activities have stretched far beyond travel and research collaboration and have impacted international education at every level at UM. At the campus level, he has played a significant role in the creation of three of UM's current international exchange agreements: with Toyo University, Moscow State University, and Lappeenranta University of Technology, Finland. His involvement was so comprehensive that in two cases it extended to the level of filling out and submitting the paperwork.

Moreover, he has expanded the international opportunities within our department. He brought distinguished international visitors to UM for extended visits, which in turn has led to faculty exchanges and new collaborations. He created and co-taught with UM Math Professor Jon Graham, a 400-level math/stat modeling course that is currently being taken by students, both at UM and, via the web, at the University College Cork, Ireland. Over the past year, Dr. Kalachev has brought two PhD students from Russia to obtain PhD degrees through the UM Math Department.

Dr. Kalachev's boundless energy and positive attitude are a force for good in our department and campus wide, and we are glad to see him being recognized for his contributions.



Notes from the Chair

By Leonid Kalachev

A very interesting and somewhat exciting academic year is coming to an end. I want to begin this column with congratulations to our graduates: a total of 3 PhD students, 3 MA students, and 23 Math Majors are graduating at the end of the spring semester of 2013. One of our graduating PhD students, Marylesa Howard, has accepted a position of Scientist (Mathematician) at National Security Technologies in Las Vegas, Nevada. The other two PhD graduates, Tien Chih and Jeff Johnson, were offered one-year postdoctoral lectureship positions in our department. Demetri Plessas, our last year's PhD degree recipient has received two job offers and accepted a position as an Assistant Professor at Northeastern State University, which is located in Tahlequah, Oklahoma.

Our C&O position search has been completed successfully. Our top candidate for the position, Cory Palmer, currently at the University of Illinois, Urbana-Champaign, has accepted a position as an Assistant Professor. He is coming to Missoula this summer before the start of the fall semester. We are very happy with the results of the search and would like to welcome Cory to our department!

During the past academic year the department continued activities related to international research and education: the dual delivery course M445 Statistical, Dynamical and Computational Modeling continued to be offered to students both at UM and at University College Cork, Ireland where it became a full academic year course. The collaboration agreement between our department and the Bio-Nano Electronics Research Centre at Toyo University, Japan, was renewed in the spring of 2013 for another five year period. During the fall semester of 2012 our department

hosted Yuri Korolev, a graduate student from Moscow State University (Russia). Several departments at sister universities are making inquiries about the possibility of starting a joint / dual degree program with the Mathematical Sciences Department at UM. I hope that our university administration will establish explicit rules for such programs sometime during the coming academic year.

Statistics and Applied Mathematics CORE (SAMC) was very active during the past academic year: several grant proposals with participation of SAMC members were submitted. We are still waiting on funding decisions from various agencies. Several graduate students, one adjunct instructor and one adjunct researcher were supported by various projects running through SAMC.

Three faculty members from our department were awarded sabbaticals for the next academic year. Dave Patterson and Solomon Harrar will be gone for the whole year, and I will be away during the spring semester of 2014. While on sabbatical, I will continue to serve as department chair.

Due to lower projected student enrollment at the University of Montana, substantial budget cuts for the coming academic year were announced and actively discussed during this spring semester at every department including ours. To reduce the costs associated with running the educational activities of the department, several sections of various math courses for the fall semester were zeroed out; the minimum enrollment requirements (at least 15 students for 100- and 200-level courses, 10 students for 300- and 400-level courses and 5 students for 500-level graduate courses) will be strictly enforced.

In this time of budget cuts and reduction of our operating budget



(by 25% for the next academic year) the support of our donors becomes even more important! A new student fellowship in memory of our former professor Bill Myers is going to be awarded annually starting in the 2013 – 2014 academic year. The major contribution to initiate this award was provided by one of our alumni, Eric Hartse. I would like to express our gratitude to all our donors and supporters. On behalf of all the faculty members, students and staff in our department, I would like to say thank you!

As always, I wish everyone a great summer! See you in the fall!

A handwritten signature in black ink, appearing to read 'Kalachev', followed by a long horizontal line.

Spring 2013 Scholarship and Award Winners

Joseph Hashisaki Memorial Scholarship

Nathan Sponberg

Anderson Mathematics Scholarship

Holt Bodish

Mac Johnson Family Scholarships

Arlan Dirkson

Mariah Smith

Jasmin York

Manis Memorial Scholarship

Ashley Tombelaine

John A. Peterson Awards for Mathematics Education

Cory Beckham

Laura Koday

Undergraduate Teaching Scholar

Nathan Sponberg

Phoebe Webb

Undergraduate Tutorial Scholars

Sam Doyle

Thea Layton

Russell Stanbery

Brian Turnquist

Liam Whaley

N.J. Lennes Competition

1st place: Johnathan Bush

2nd place tie: Jonathon Knudson

2nd place tie: Patrick Tresslar

Honorable Mention: Jessica Hurd

Graduate Distinguished Teaching Awards

Nicholas Grener

Marylesa Howard

Graduate Student Summer Research Awards

Adam Clinch

Doug Holstein

Beth Lask

Mike Severino

Bertha Morton Scholarship

Adam Clinch

Meredith Berthelson

Washington Native American Scholarship

Meredith Berthelson

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Pi Mu Epsilon: Kegan McNeill-Rabil

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New Carolyn and Johnny Lott Scholarship Established

By Matt Roscoe

Johnny and Carolyn Lott have long been associated with mathematics education at the University of Montana. Johnny is an emeritus professor of the Department of Mathematical Sciences in the College of Arts and Sciences. He now serves as the director of the Center for Excellence in Teaching and Learning at the University of Mississippi. Carolyn is a retired professor of the Department of Curriculum and Instruction in the Phyllis J. Washington College of Education and Human Sciences. This couple's historic commitment to mathematics and education has recently been supplemented through the establishment



Emily Wilson was this year's recipient of the Carolyn and Johnny Lott Scholarship.

of a new permanent scholarship endowment: The Carolyn and Johnny Lott Scholarship.

The undergraduate scholarship is awarded through the Department of Mathematical Sciences. It is the only scholarship available in the department that is restricted to elementary education majors. Applicants must have successfully completed the required courses in mathematics for elementary education majors (M135 and M136), earning a grade of B or higher in each course. A cumulative grade point average of 3.0 or higher is necessary. A letter of recommendation from a mathematics educator must be submitted. One condition that makes the scholarship unique among those awarded in the department is the requirement of a "mathematical essay" that addresses an interesting math problem which is chosen by the selection committee.

In a recent interview, Johnny and Carolyn explained that their decision to support elementary education majors was a "natural fit" given the fact that they both spent a significant portion of their careers at the University of Montana preparing elementary school teachers. Johnny went on to emphasize that the role of the elementary school teacher is essential, noting that, "Many student attitudes are developed in elementary and middle school and we want the best teachers working with them, meaning that these teachers need to understand and like mathematics as well. We hope the scholarship provides some incentive."

When asked about their decision to require a mathematical essay, the Lotts explained that the idea was the result of an evolving conversation involving Dr. Leonid Kalachev in the Department of Mathematical Sciences and Dr. David Erickson in the Department of Curriculum and Instruction. When they were deciding on the criteria for the award several options were considered, including the submission of an original lesson plan and the solution to a mathematics problem. Deciding on a mathematical essay provided a good alternative in that it allowed the selection committee the opportunity to appraise a future teacher's mathematical knowledge as well as their ability to explain mathematical concepts, that is, a way to judge a teacher's competencies in terms of mathematical content knowledge and mathematical pedagogical knowledge.

Promoting an application process that is driven by both content and pedagogy was clearly an intentional decision by the Lotts. The scholarship endowment stipulates that the selection committee be comprised of educators from the Department of Mathematical Sciences and the Department of Curriculum and Instruction. Johnny commented, "Having a selection committee of mathematics educators from both math and curriculum and instruction seemed like a good way to involve two departments where the applicants study. And it provides one more small avenue where the two groups can continue to work together."

Johnny and Carolyn chose to establish the permanent scholarship as a way that they could give something back to the University while helping students who want to become teachers of mathematics to the youngest of learners. The Department of Mathematical Sciences recognizes the gracious gift that the Lotts have offered and responds with a hearty "thank you" along with a promise to carry their wishes forward into perpetuity.

Eight Years of Retirement

By Rudy A. Gideon

I retired in June of 2005 after 35 years of learning probability and statistics, trying to pass some of it on, and trying to produce something new. In retirement I have attempted to formulate and disseminate a broad system of parameter estimation using correlation coefficients. To do any research one needs a support group. I have three computers, one iPad, and an office in Corbin Hall. Carol Ulsafer has worked with me about twice a week for over eight years in writing statistical articles as well as in the joy and sorrow of the submission process. Guy Shepard maintains my office computer.

It is sometimes difficult to continue taking the time to produce research. My parents were alive when I retired, but they needed help before they each died in their 90s. My wife continues to have serious health issues. And, of course, one needs to generate new statistics by playing golf. The reader should understand that the complexities of life are always to be reckoned with. Children and grandchildren connect me to the younger generation.

In the 1980s, working with graduate students, I invented a new correlation coefficient, called the Greatest Deviation CC. Shortly after, I started to wonder why CCs are not really used in the estimation and inference process. To answer, I started to build what I called the correlation estimation system or CES; I have worked on it ever since.

Computers are always demanding and after retirement the S-PLUS system was abandoned by the department because of cost and that meant changing over to the cost-free R application. After one paper was accepted and the revision prepared, the journal required a LATEX version. Carol and I did not know anything about it,

so we had to learn it by trial and error, scanning the manual, and with help from several associates.

Some of the reviewers did not seem to understand the material in the papers. We had to reduce one paper from 30 pages to 10. Another journal sat on a paper for two years with no comment. Finally, after prodding, the editor said it was an interesting paper and published it. The favorite review came from the Journal of Data Science: the reviewer ran all of the R programs, found errors in some of the tables, and offered numerous good suggestions. The stupidest review said that ASA readers can only learn least squares and they should not be expected to learn new ideas. I have learned that, depending on the journal, CES is either too theoretical or not theoretical enough.

The four published papers since retirement involve: a general definition of correlation and an introduction to some new ones, scale estimation, an asymptotic derivation of the distribution of multiple linear regression estimates, and a general outline of CES using R computer code. Current concepts being worked on are: an estimation of probabilities in general linear models, the use of CES in Kendall's Tau, and the connection between CES asymptotics and Pitman efficiency.

Why do we work on research in our capitalistic society when I could do a number of other things, such as play bridge like Carol? There is no material reward and hardly any reward at all, but we do enjoy the camaraderie. We have heard that continuing with work like this might stave off senility and there are a few laughs among Carol, Joyce Schlieter, and I. Joyce sometimes brings cookies. Finally, there is the satisfaction of knowing that I am the only person in the world who can do this stuff, and unfortunately Carol is the only one who has to listen to it.

Degree Recipients 2012-2013

BA in Mathematical Sciences

Intizor Aliyorov
Darius Baum
Neil Bennett
Kendra Brooks
Michael Decker
Erinn Della

John Finlay
Jesse Finneman
Patrick Funk
Laura Koday
Jason Kolberg
Stuart Landers

Mikel Miller
Lauren Morey
John Pueringer
Kegan McNeill Rabil
Savanna Riebe
Ryan Robertson

Kaitlyn Rolshoven
Melissa Walker
Ericka Wells
Laura Wilson

MA in Mathematical Sciences

Jesse Adams
Vicki Aegerter
Alexander Aiken
Douglas Holstein
Charles Katerba

Nicole Leibach
Kelly Marker
Lorri O'Neill
Takehiko Yamaguchi

PhD in Mathematical Sciences

Marylesa Howard
Advisor: John Bardsley
Computational Methods for Support Vector Machine
Classification and Large-Scale Kalman Filtering

Jeffery Johnson
Advisor: Thomas Tonev
Peripherally-Multiplicative Spectral
Preservers between Function Algebras

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Anderson Fund - an endowed scholarship for a student majoring in mathematics

Joseph Hashisaki Fund - an endowed scholarship for one or two upper-class math majors based on academic achievement

Mac Johnson Family Fund - endowed scholarship for undergraduate students showing promise in mathematics

Manis Memorial Fund - an endowed scholarship for a student majoring in mathematics

George and Dorothy Bryan Endowment - an endowment in support of undergraduate and graduate students

Lenes Fund - an endowment to provide funds for the Lenes Exam Competition

Colloquium Fund - an endowment to provide funds to bring in visiting speakers.

Please consider a gift to one of these funds or to the Math Department's Excellence Fund to be used where the need is greatest.

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Jim Hirstein Wins New Teaching Award

Montana State University has created a new series of awards in honor of Bill Stannard. Bill was a long time Professor of Mathematics Education at Eastern Montana College (now Montana State University of Billings). One of these is the Award for Excellence in Mathematical Sciences Instruction to be presented to a deserving faculty member in the Montana University System. The Department of Mathematical Sciences at MSU has announced that Jim Hirstein has been selected to receive the inaugural award for 2012-13. In his letter of appreciation and acceptance, Jim said, "I know the positive impact that Bill has had on mathematics education in Montana, so I am proud to be selected for this award. I have had the opportunity to work with so many excellent and dedicated mathematics teachers throughout the Montana University System; it makes this award truly a high privilege for me."



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