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## Bytes of $\pi$ , Spring 2016

Department of Mathematics, Bridgewater State University

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# Bytes of $\pi$

Newsletter of the BSU mathematics department

Volume 6, No. 1: Spring 2016

Editors: Annela Kelly and Heidi Burgiel

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## Letter From the Editors

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The 2015-2016 academic year has been exciting. In contrast to last year, we have enjoyed a warm El Nino winter and spring. The mathematics department celebrated Pi day right after Spring break with student Pi(e) activities and faculty enjoyed the culinary bites of  $\pi$ . Departmental seminars and Math Chats have been well attended with engaging talks given by guests, students and faculty; Professor Jim Propp of the University of Massachusetts at Lowell gave The Abramson Colloquium talk “Math, Magic, and Mystery” on April 10 at the Pi Mu Epsilon induction ceremony. In addition, the department has been busy with curriculum development and a five year self-study report.

Read on to learn about new hires, alumni, student and faculty research, awards, assessment, and programs in our department.

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## Alumni Corner

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**We asked two alumni the following questions:**

- a) Please describe what you are doing now.
- b) Please describe your favorite class/activity/event at BSU.
- c) What advice would you like to give to current BSU students?

**Camille Schulman**, '15, Mathematics and Elementary Education majors in Spring 2014 and Masters in Special Education in Spring 2015.

Currently working in Plainville as a special education teacher.

I am a special education teacher assigned to a Therapeutic Learning Classroom. I create and implement a modified curriculum for my students based on their current abilities, needs, and individual education programs.

My favorite activity at BSU was participating in community service through BSU Buddies, Circle K, and the Belize service trip.

My advice for current BSU students is to get involved with something you're truly passionate about. There are so many great opportunities at BSU, you just have to take the time to find the right one for you.

**Karen Leary Duseau**, '97, Math & Physics major, Management minor.  
Mathematics instructor at Bridgewater State University.

I am currently working on my Ph.D. in Mathematics Education at UMass Dartmouth. I love mathematics and I feel passionately about sharing my knowledge with others, so a program in Mathematics Education is a wonderful combination of the things I love!



During the last six years I have taught Mathematics at Weymouth High School. This year, I am fortunate to have the opportunity to teach full time at Bridgewater State University. I LOVE BSU! It has been so much fun to come back and teach with so many of the professors who taught me!

There are a few things that stand out in my memory about BSU. First are the professors; Dr. Heilman, Mathematics, can make upper level mathematics accessible to anybody; Dr. Shama, Mathematics, always remembers her students are so much more than numbers; Dr. Healy, Physics, taught me to believe in myself; Dr. Street, Communication, taught me so much more than how to argue; Dr. Marganian, Chemistry, taught me how dangerous pollution is; Dr. Sevigny, Accounting & Finance, taught me the value of money. I could go on and on. The second thing that stands out to me was the small cohort of physics students and faculty who hung out in the stock room/physics lab to work and socialize. This cohort supported me through my experience and made me feel like I belonged here at BSU. This is my school and they are the reason I believe that. My advice to current BSU students: Follow your heart. Don't give up! Become an active participant at BSU. Seek support. You are not alone. If you have trouble in math, come see me.

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## New Faculty Bio

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**Dr. Stephen Flood** joined Bridgewater State University this fall as an assistant professor. He received his Ph.D. in Mathematics at the University of Notre Dame in 2012. Since then, he has taught at Pennsylvania State University and the University of Connecticut.

Stephen's research focuses on the interplay between mathematical logic, combinatorics, and computability theory. In a variety of contexts, this research tries to answer the question "How hard is it to prove this theorem?"

Outside of Bridgewater, Stephen enjoys catching up with family, reading books on philosophy and theology, and spending time at the beach in Cape Cod. When he has time, he also enjoys the sport of fencing.

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## New Hires

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**Benjamin Cote** is currently finishing his PhD at University of California, Santa Barbara. His dissertation: "Affine complex reflection groups and associated braid-like groups" will be completed in June 2016.

**John Pike** comes to us from Cornell University. In 2013 he received a Ph.D. in applied mathematics from the University of Southern California.

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## Record Breaking Undergraduate Research

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In the spring of 2015, BSU set a national record by sending students to the prestigious Posters on the Hill (POH) undergraduate research event six years in a row. This event takes place in Washington, DC and is sponsored by the national Council on Undergraduate Research (CUR). In addition to presenting their research, students are charged with meeting elected representatives at the Capital Building to communicate the importance of funding undergraduate research.

This April, BSU's record was extended to seven years when the poster "Modeling the Consequences of Reduced Vaccination Coverage on the Spread of Measles" submitted by **Guillermo Ortiz** (mentored by **Irina Secleanu** and **Kevin Rion**) was one of the 60 posters selected for the POH event out of several hundred applicants. In 2014 math major **Robert Guillette** 2014 presented "Modeling the Retreat of Glaciers in a Changing Climate" (mentor **Irina Secleanu**) at POH, making this the second time a student from our department has been selected for this event in these seven years.

Mr. Ortiz' poster is titled "Modeling the Consequences of Reduced Vaccination Coverage on the Spread of Measles", and in his research he and his mentors introduced a hierarchical statistical SEIR (Susceptibility, Exposure, Infectious, Recovered) model to describe the dynamics of a measles outbreak, and wrote code to graphically display a simulation of the measles outbreak. Because his model allows for the vaccination level to be specified, the simulations suggest there is a very high probability of a major epidemic in communities in which measles vaccination levels drop to around 75%, and are extremely improbable when the vaccination level is at the CDC prescribed 94% level.

Another of our students, **Emanuel Zanzerkia** (mentored by **Kevin Rion**) also had his research project "A Critical Analysis of Random Response Techniques" selected by CUR for honorable mention for the POH event. His research was focused on describing the performance of what are called random response techniques. It is possible for researchers to ask people sensitive questions (have you ever shoplifted?) in such a fashion that they can succeed in both protecting the privacy of the respondent and in still estimating unknown population parameters (proportion of us who have shoplifted). This is done by introducing random noise into the responses, but it has the effect of a loss of efficiency (larger samples are needed). Emanuel critically assessed the performance of standard methods for doing this, and found they often give poor estimates. In his work he

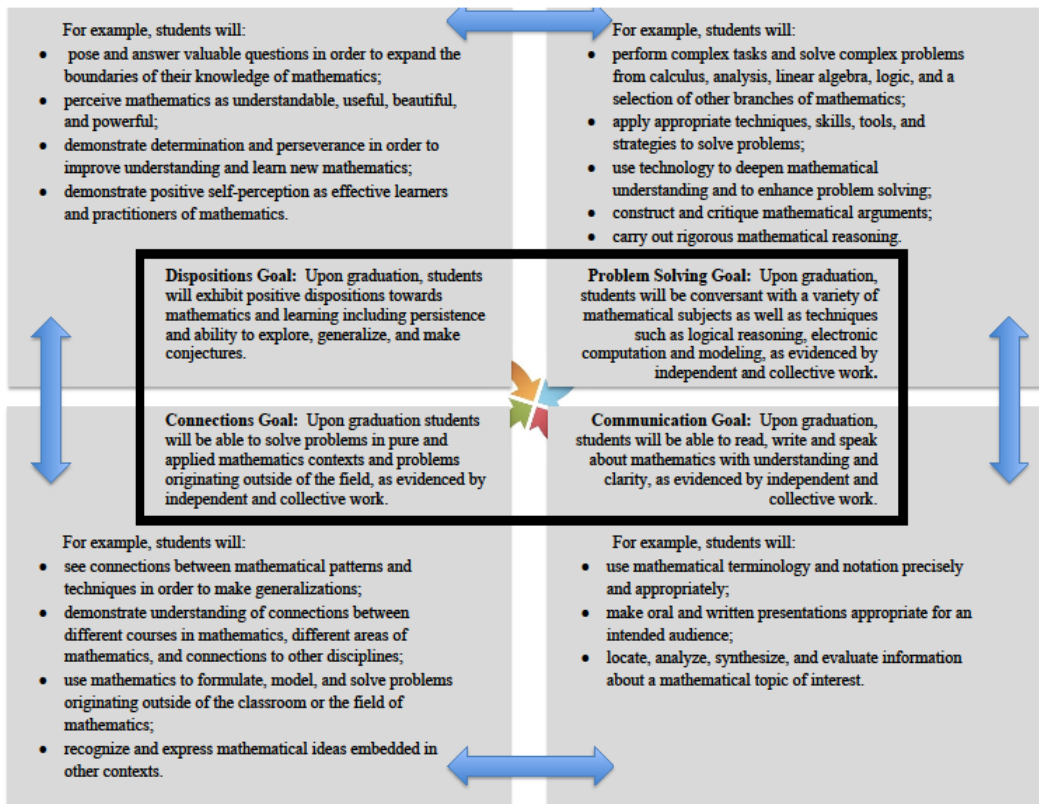
introduced entropy based methods to quantify the level of privacy the random response methods afford the participants, and then compared their efficiency at specified levels of privacy. He also used a Bayesian estimator that gives admissible estimates when some of the standard methods fail to.

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## Assessment and Outcomes

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The department's assessment committee has been working for five years to assess and improve courses for our majors. On March 16, we voted on the learning goals and outcomes illustrated below. Our next steps are to develop and apply rubrics to evaluate our progress toward these outcomes, and to establish a tradition of responding to the results of our assessments.




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## Engage in Math

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The Engage in Math program is directed by **Polina Sabinin** and hosted by the BSU Center for the Advancement of STEM Education (CASE). It combines two existing programs – Games Teachers Play and the Math Kangaroo competition at BSU – with new outreach efforts in K-12 education.

This year, through Engage in Math, Dr. Sabinin has offered seminars for teachers and parents of students in grades K-12. She also provided general consulting and coaching for teachers at the high school level. Dr. Sabinin mentored student Sarah Dymek in

developing and running a family night at Parkview Elementary school in Easton. She looks forward to mentoring more students in the coming years and giving them opportunities to work with local schools.

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## **Supporting the Mandela Washington Initiative**

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The Mandela Washington Fellowship – the flagship program of President Obama’s Young African Leaders Initiative – empowers young leaders from Sub-Saharan Africa. This summer, a cohort of 25 fellowship recipients will spend six weeks working at BSU. The second week stresses the modernizing impact of public works projects led by math faculty member **Uma Shama**; the topic of study is infrastructure planning and implementation: Foundations for a Vibrant Economy.

After 20 years as co-director of BSU’s GeoGraphics Lab, Dr. Shama is intimately familiar with the ways in which technological advances affect transit and urban systems. Topics covered in her sessions include water purification and conservation, applying green chemistry and sustainability principles for alternative energy, transportation megaprojects, design and constructions of public buildings, and smart cities/smart places technology.

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## **Research Abroad**

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**Polina Sabinin** and **Niki Glen** (Elementary Science Education) received an Undergraduate Research Abroad grant for their project titled: “Exploring STEM Curriculum, Instruction, and Professional Development in Georgian Primary Schools”. The project is funded by the BSU Shea Fellowship and Undergraduate Research Office and includes four undergraduate students: **Sarah Drinkwater**, **Kaitlin Kummer**, **Carolyn Walcott**, and **Gary Parmenter**. The group will travel to the Republic of Georgia on May 21 - June 4, 2016.

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## **Student News**

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### **Research, Honors Theses and Presentations**

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Several students conducted summer Adrian Tinsley Program research in summer 2015:

**Terrence Kelleher**, “Exploring the Linear Independence of Matrix Represented Dihedral Groups when Multiplied by a Vector” (Mentor: **Dr. Shannon Lockard**)

**Christopher McDonald**, “Classification of Wavelet Sets on the Real Line” (Mentor: **Dr. Vignon Oussa**)

**Guillermo Ortiz**, “Modeling the Consequences of Reduced Vaccination Coverage on the Spread of Measles” (Mentor: **Dr. Irina Seceleanu**)

**Nicholas "Necco" Pasciuto**, “The Mystery of Non-transitive Grime Dice” (Mentor: **Dr. Ward Heilman**)

**Emanuel Zanzerkia**, “A Critical Analysis of Random Response Techniques” (Mentor: **Dr. Kevin Rion**)

**Arianna Zikos**, “A Canonical Classification of Coordinate Systems Arising from Linear Transformations” (Mentor: **Dr. Vignon Oussa**)

**Molly Bennett**, “Making Learning hAPPen: Exploring the Benefits of Using iPads to Enhance the Learning of Geometry in an Eighth-Grade Classroom” (Mentor: **Dr. Patricia Emmons**)

**Terrence Kelleher, Christopher McDonald, Guillermo Ortiz, Emanuel Zanzerkia** and **Arianna Zikos** presented their research at the national Joint Mathematics Meetings in Seattle in January 2016. In addition, **Nicholas Pasciuto** gave a talk at the NES/MAA Fall 2015 Meeting at Gordon College on November 20th 2015 on “The Mystery of the Grime Dice”. **Guillermo Ortiz** and **Emanuel Zanzerkia** also completed honors theses based on their ATP research. Four more honors theses written in the department are:

**Nicholas Fonseca**: “Optimizing a Game of Chinese Checkers” (Mentor: **Jackie Anderson**)

**Christopher McDonald**: “Characterization of Four Interval Wavelet Sets and Algorithms” (Mentor: **Vignon Oussa**)

**Frederick Neilan**: “(Knight)<sup>3</sup>: A Graphic Perspective of the Knight's Tour on a Multi-layered Chess Board” (Mentor: **Shannon Lockard**)

**Maxwell Norris**: “Automated Floor Plan Modeling using a Low-Cost LIDAR Laser Rangefinder and a DuinoBot Controller” (Mentor: **John Santore**)

ATP award winners for summer 2016 are:

**Lynn Freshour**, “Analysis of the Effects of El Niño & La Niña upon Flood Insurance Premiums across Different Parts of the United States” (Mentor: **Dr. Annela Kelly**)

**Gregory Hamalian**, “Building the Perfect NBA Team” (Mentor: **Dr. Ward Heilman**)

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## **Engaging in Mathematics Competitions**

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**Christopher McDonald** took the prestigious Putnam exam in December 2015. He got a positive score on the exam – the highest scorer from BSU in at least ten years!





Students **Arianna Zikos**, **Brian Witzgall**, **Christopher McDonald**, **Nicholas Fonseca**, **Danielle Sanders** and **Patrick Houlihan** (pictured above) presented at the Tenth Annual NES/MAA Collegiate Mathematics Competition at Gordon College, MA on November 20, 2015. Both of our teams were among the top third!

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## Faculty News

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**Matt Salomone** and Tom Kling have published the article “Creating a Peer-Led Cooperative Learning Program to Improve STEM Retention” in *Change: the Magazine of Higher Learning*.

**Uma Shama** was invited to address a symposium on geospatial technology in transportation during the GeoSmart India 2016 International Conference in March. The title of her talk was “Demonstrating real-time web mapping of inter-regional intermodal passenger transportation”.

**Vignon Oussa** was invited to give a presentation at the 2016 Spring Central Sectional Meeting in the Special Session on Frames, Wavelets and Gabor Systems. The title for the talk is: A classification of irreducible admissible groups in dimension three. This is a preliminary report on a joint work with Hartmut Fuhr (RWTH Aachen, Germany) and Bradley Currey (Saint Louis University, MO). He has also published the following articles:

“Decomposition of Rational Gabor Representations”, *Contemporary Mathematics*, *Contemporary Mathematics* 650, 37-54 (2015);

“Dihedral Group Frames which are Maximally Robust to Erasures”, *Linear and Multilinear Algebra*, Volume 63, Issue 12, 2015;

“Computing Vergne Polarizing Subalgebras”, *Linear and Multilinear Algebra*, Volume 63, Issue 3; (2015);

“Sampling and Interpolation on Certain Nilpotent Lie Groups” (jointly with B. Currey and A. Mayeli), *SampTA 2015*, the 11th International Conference on Sampling Theory and Applications (2015).

**Jacqueline Anderson** will be receiving a Provost Scholar award, reducing her teaching load so that she can focus on research.



**Heidi Burgiel** will be taking a year's leave of absence to attend the Harvard Graduate School of Education's one year Master's program in Technology, Innovation, Education.

Presentations at the national Joint MAA AMS Meeting in Seattle in January 2016:

**Heidi Burgiel:** *Application of Doily Design to Hyperbolic Crochet.*

**Laura K. Gross**, jointly with Jun Yu, University of Vermont, Yi Yang, Emory University, Kewang Chen, University of Vermont: *On a generalized free-interface model of solid combustion.*

**Ward Heilman**, jointly with **Leonard Sprague** and **Nicholas Pasciuto:** *Grime Dice and the Archbishop.*

**Annela Kelly:** *College Graduates and Marketable Learning Outcomes.*  
and *Flipping Coins to Normal Distribution.*

**Shannon Lockard**, jointly with Timothy Flowers: *Hyper m-ary partition sequences.*

**Polina D. Sabinin:** *Rewarding commitment and community-building in a college mathematics classroom.*

**Irina Seceleanu**, with **Ward Heilman**, **Matthew Shipman** and **Robert Guillette:**  
*"Wherehouse" Route Optimization Software for the Warehouse Picking Problem.*

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## Problem Corner

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The mathematical honor society Pi Mu Epsilon publishes problems suitable to a wide range of undergraduate students. Below is one problem found at:

<http://pme-math.org/pme-journal-problem-department>

in advance of the publication of the Journal.

Solutions submitted to [Steven.J.Miller@williams.edu](mailto:Steven.J.Miller@williams.edu) may be published in the Pi Mu Epsilon Journal.

The following problem is an expanded version of a problem from the 2013 Green Chicken Math Competition between Middlebury and Williams College: Show that there is a positive Fibonacci number that is divisible by 1000, and find the smallest such number; more generally, find all positive integers  $N$  such that there exists a positive Fibonacci number  $F_n$  which is divisibly by  $N$ , and for such  $N$  give a bound for the smallest index  $n$  that works in terms of  $N$ .

(#1314: Proposed by Pete Schumer, Middlebury College, Middlebury, VT 05753)

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To respond to an article in this newsletter or report your news, please email Heidi Burgiel ([hbürgiel@bridgew.edu](mailto:hbürgiel@bridgew.edu)) or Annela Kelly ([a3kelly@bridgew.edu](mailto:a3kelly@bridgew.edu)). We look forward to hearing from you!