

Mathematics at UMW

Fall 2014

a newsletter of the Department of Mathematics at the University of Mary Washington

Welcome from the Chair

The first thing you may notice is that Keith Mellinger is not writing this note. Sure enough, I took over as chair of the department in January of this year. The university called on Keith to lead and manage our Quality Enhancement Plan, an important part of our reaccreditation requirements. It's a big job, one that precludes the time and ability to serve as chair, so I stepped in with the start of the spring term.

You may be pleasantly surprised at some of the physical changes you see on campus this fall. The Information and Technology Convergence Center (ITCC) is now open for business. I took a tour of the building before its grand opening and was completely blown away by the design of this facility. The ITCC has something to offer for everyone and is a complete game-changer in how we collaborate and teach at UMW. In addition to housing the Writing and Speaking Centers, there is a multitude of different types of collaboration space and innovative classroom technologies. If you find yourself on campus you should definitely explore the building. Also, you will see that much progress has been made on the new student center (where Chandler Hall used to reside). This building will be quite the upgrade from Seacobeck Hall and should offer a generous amount of much-needed space for student activities.

We are also seeing positive change in the Department of Mathematics. We have a new minor in Actuarial Science on

the books this fall, presenting a great opportunity for rigorous preparation for this very lucrative career path. We have an exciting new research collaboration program with the Naval Surface Warfare Center at Dahlgren, spearheaded by Debra Hydorn. In this arrangement students work with Dahlgren scientists on real projects of interest, gaining job experience and exposure to what it's like to "do mathematics" as part of one's career. Each year we have more and more students taking advantage of internship opportunities. Suzanne Sumner has helped many students intern in local schools with her Caroline County Public Schools grant, and plenty of other students have secured internships at private firms. And as always, undergraduate research is still going strong in our department, with many of our students' work featured in the following pages of this newsletter. If you are a current student here, now is the time to get involved.

As mentioned, I am very new to the position of chair of the department, but as I become more immersed in the job I am becoming increasingly impressed with what our students and faculty are accomplishing. The same goes for our alumni. You don't always realize the depths of what's going on when viewed only from the boundary. This has always been a great place to study mathematics and it's only going to get better.

Best wishes for a great year. Please stop by and visit us whenever you're close by.

Randall Helmstutler
Chair, Department of Mathematics

Departmental Transitions



*Christopher Gray,
visiting instructor*

The close of the Spring 2014 semester brought the retirement of Senior Lecturer Mrs. Patricia Dean. Pat served the department for over twenty years, teaching many of the 100- and 200- level offerings and serving as an Honor Council faculty advisor. Pat plans to spend her new-found time with her two grandchildren and will be greatly missed in the department. Joining the department is Visiting Instructor Christopher Gray. Christopher is a native of the Northern Virginia area and holds a Masters degree from George Mason University. At George Mason, Christopher studied Algebraic Combinatorics, and hopes to expand his research in this field and also explore its application to finite convex geometry. Outside of teaching and mathematics, he enjoys philosophy, reading, and hiking.

Two members of the department were promoted at the close of the 2013-2014 academic year. Leo Lee was awarded tenure and promoted to Associate Professor. While Leo is on sabbatical this fall semester, in the spring he can be found in his new office in Trinkle 126. Also, Keith Mellinger was promoted to full Professor and has been serving the University through his appointment as Director of UMW's Quality Enhancement Plan.



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where great minds get to work

Jepson SSI Projects

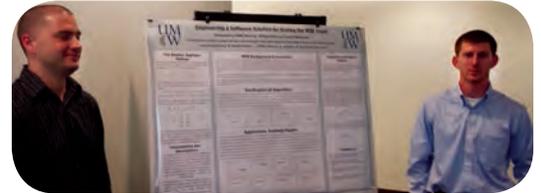


Left to right: *Caceres, Denhere, Moore*

Marlene Caceres and **Victoria Moore** worked on statistical projects in the emerging field of functional data analysis with Dr. Melody Denhere. By way of simulation study and application to real world data, Victoria carried out a comparative study on the effect of the basis choice in the functional linear regression model. The study tested the effects of choosing between three of the widely used basis functions - the Fourier basis, the B-spline basis, and the monomial basis. Using R for simulations, her results from the simulation study and the real data supported the fact that the Fourier basis works best with periodic data, while the other two basis functions were ideal for the non-periodic data.

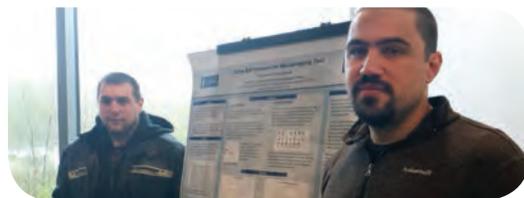
Marlene's project was titled *The Curse of Dimensionality in Functional Data*. Marlene's project focused on reducing the dimension of the functional data model by applying some multivariate statistical methods to a reduced form of the functional regression model. These methods were principal component analysis (PCA), factor analysis (FA), and stepwise regression. The study consisted of investigating applicable methods that could be used for dimension reduction and elimination of multicollinearity, generating functional data with a distinctive pattern, then applying the dimension reduction methods and determining how well the reduced data retained the original trend. Marlene used measures of model efficiency to determine that on average, PCA was the best at retaining the variation in the data followed by FA with the stepwise method being the least effective.

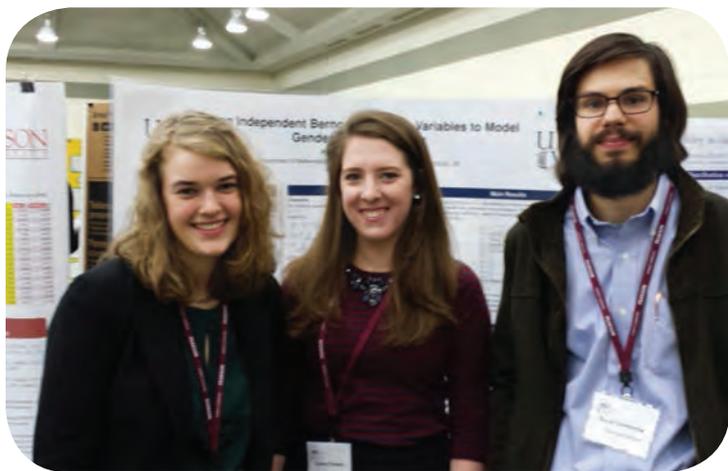
Dahlgren Research



Working under the direction of researchers at the Naval Surface Warfare Center Dahlgren Division and UMW faculty, five mathematics majors completed undergraduate research projects during the Spring 2014 semester. The students were joined by two computer science majors and one business major. This new program, to provide undergraduate research projects in business, industry, and government, was initiated by Debra Hydorn and Stephen Davies (CPSC). The mathematics and computer science departments have plans to continue this collaboration with new project opportunities for students each semester. Last spring's project titles and participating students are listed below, along with their UMW mentors:

- Statistical Modeling and Analysis of Counts in Time: **Kimberly Hildebrand** and **Candice Benschhoff** (Drs. Hydorn and Davies)
- Citation Prediction and Analysis: **William Etcho** and **Josiah Neuberger** (Dr. Denhere)
- String Edit Distance for Micro-blogging Text: **Anthony Bell** and **Jonathan Blauvelt** (Dr. Hydorn)
- Simulation of a Social Network Graph: **Cody Reibsome** and **Benjamin Blalock** (Dr. Davies)





Left to right: Hildebrand, Howren, Lawhorne

Student Travel

Extending research from the previous summer, three students traveled to Baltimore, MD in January 2014 to present their work at the Joint Mathematics Meetings. **Casey Howren** continued working on her research project with Dr. Leo Lee. During the summer, she analyzed her disease model numerically using Euler's method after finding the exact solution. In 2013-2014, she used many other numerical algorithms to approximate her model and compared the outputs of different numerical methods (for instance, Taylor series, midpoint, modified Euler's, Runge-Kutta, and multistep methods). She also developed her own computer programs for each method, and presented this work during the meetings' MAA undergraduate poster session.

Kimberly Hildebrand presented her project from the 2013 Summer Science Institute "Using Independent Bernoulli Random Variables to Model Gender Hiring Practices." Her project examined gender bias in hiring practices based on the level of educational attainment. The number of women hired for a set number of positions was simulated using independent Bernoulli random variables and a variety of Beta distributions. Simulations were run using the statistical program R. Her results could be used as evidence to support gender bias in hiring, depending on the proportion of women applicants for a certain situation. In addition to presenting this work at the MAA poster session during the Joint Meetings, Kim also received an undergraduate research travel grant from UMW to present this work at the 2014 MAA MathFest in Portland, OR.

Also at the poster session, **Dane Lawhorne** presented his research in topology. Dane's presentation concerned his

work conducted under Dr. Helmstutler over the previous summer and into the fall, leading to his honors thesis: you can read all about the details in the Honors article in this newsletter. Dane received special recognition from the MAA, placing in the top 15% of all presenters.



Honors Projects

Kyle Genovese completed a thesis project under the guidance of Dr. Esunge, focusing on two applications of a statistical technique called multiple regression. Her work was a culmination of a yearlong study that began during the 2013 Summer Science Institute, and ended with a successful defense before the mathematics department faculty.

In her honors thesis, **Casey Howren** used computational techniques to model the projected course and severity of epidemics, focusing on the H1N1 outbreak. The model used was a system of non-linear differential equations for which she was able to derive an exact solution. Casey was also able to develop algorithms with corresponding codes for several numerical methods, including Adams predictor-corrector method. Her work culminated in an excellent 51-page long thesis.

Christopher A. Hunt completed his honors thesis under the direction of Dr. Chiang on "Surface Theory, Minimal Surfaces and Weierstrass Representations." In his thesis, he studied surface theory and applied it to minimal surfaces. He then investigated Weierstrass representations for various minimal surfaces. Hunt is double majoring in Mathematics and Computer Science, and expects to graduate in December 2014.

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Honors Projects (continued)

Based on his work with Dr. Helmstutler from the 2013 Jepson Summer Science Institute, **Dane Lawhorne's** honors thesis characterized the homotopical and algebraic behavior of certain “digital” topological spaces. The spaces in question are either countable or finite, yet they share many of the exact same properties of the Euclidean line and unit circle. For instance, Dane showed that the digital line has the same fundamental group as the real line and that the digital line serves as the universal covering space of any digital circle, just as the real line behaves with respect to the unit circle. Moreover, Dane proved that the automorphism group of the digital line may be represented as the dihedralization of its translation subgroup, which is exactly the characterization of the isometry group of the ordinary real line. Dane will begin his doctoral studies at University of California Riverside this fall, with plans to specialize in topology and category theory.

Sumner wins award for outstanding teaching

Dr. Suzanne Sumner was awarded the 2nd Annual Chi Beta Phi Faculty Award in the spring of 2014. Students nominate professors for this award, which seeks to acknowledge exceptional professors in the sciences and mathematics who exhibit adoration for teaching, contributions to the university as a community, and a genuine outreach to students. Sumner is an active member of Delta Kappa Gamma, an international honor society for female educators, as well as the advisor for the mathematical honor society Pi Mu Epsilon at UMW. According to students, Sumner always has an open door and her passion for teaching math is contagious.



8th Annual Calculus Tournament

The Department of Mathematics sponsored its eighth annual Calculus Tournament for regional high schools on March 29, 2014. This year's tournament, organized by Larry Lehman and Jennifer Magee, featured six teams from four high schools—two teams from Mountain View High School (Stafford County), two from Paul VI High School (Fairfax), and one each from Orange County High School and Fredericksburg Academy. Morning round-robin matches whittled the field down to four teams. In the afternoon semi-final rounds, Paul VI's girls' team defeated Paul VI's boys' team with a comeback win on the final question, while Mountain View's first team eliminated Orange County in the other semifinal. Paul VI defeated Mountain View in the final round, to claim the team competition.

Members of the first and second place teams were awarded cash prizes. Participants also had the opportunity to compete in an individual written exam, with cash prizes for first and second places. The cash prizes totaled \$650. All participants were given t-shirts and enjoyed breakfast and lunch at the tournament. This year's tournament was funded through a generous contribution from Dynovis.

Special thanks to the UMW student volunteers and faculty moderators Drs. Helmstutler, Konieczny, Lehman, and Mellinger who helped the tournament run smoothly.



Faculty Highlights

Yuan-Jen Chiang had a research book “Developments of Harmonic Maps, Wave Maps and Yang-Mills Fields into Biharmonic Maps, Biwave Maps and Bi-Yang-Mills Fields” published by Birhauser, Springer, Basel, in the series of “Frontiers in Mathematics.” She also had three articles published last year and presented a paper at a Mathematics Department colloquium at National Taiwan Normal University.

Melody Denhere presented on “Robust Penalized Functional Logistic Regression” at the Joint Mathematics Meetings in Baltimore, MD. She also participated in a special session on Robust Functional Data Analysis at the Joint Statistical Meetings in Boston, MA where she delivered a presentation titled “Robust Methods for the Functional Generalized Linear Model.”

Julius Esunge gave presentations in Colorado and New York this year. His paper “Optimal combined dividend and proportional reinsurance policy” was accepted and will appear in the journal *Communications on Stochastic Analysis*.

Randall Helmstutler published the paper “Conjugate pairs of categories and Quillen equivalent stable model categories of functors” in the *Journal of Pure and Applied Algebra*.

Debra Hydorn was asked to serve as a mentor at the 2014 AAC&U Project Kaleidoscope Summer Leadership Institute at Pendle Hill in Wallingford, PA. At the institute she helped lead sessions on current trends in STEM education and on how to avoid burnout.

Janusz Konieczny published two papers this year, including “Conjugation in semigroups” in the *Journal of Algebra*. He also gave the invited talk “The Commuting Graph of the Symmetric Inverse Semigroup” at the Analysis, Logic, and Physics Seminar at Virginia Commonwealth University.

Leo Lee was invited to present his work on Domain Decomposition Methods for Solving Stochastic PDEs at the US-Korea Conference on Science, Technology, and Entrepreneurship in East Rutherford, New Jersey in August 2013. He also presented his work at the Joint Mathematics Meetings in Baltimore.

Larry Lehman gave a talk at the fall 2013 section meeting of the MAA hosted by Longwood University applying techniques from number theory to determine when the open-topped box problem in calculus has rational number solutions.

Jennifer Magee attended both the fall 2013 and spring 2014 section meetings of the MAA to participate as a section NExT fellow. There, she participated in workshops and discussions aimed towards faculty members in their first years of teaching mathematics at the university level.

Keith Mellinger traveled to London, England last summer to attend the British Combinatorial Conference. There, he spoke on his joint work with alumnus Kelly Scott. This work was published last spring in the *Journal of Combinatorial Designs*.

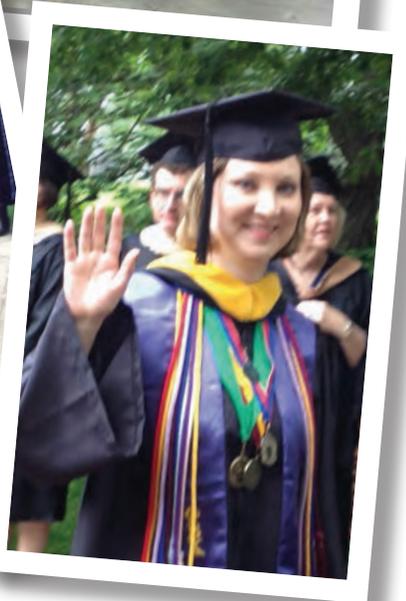
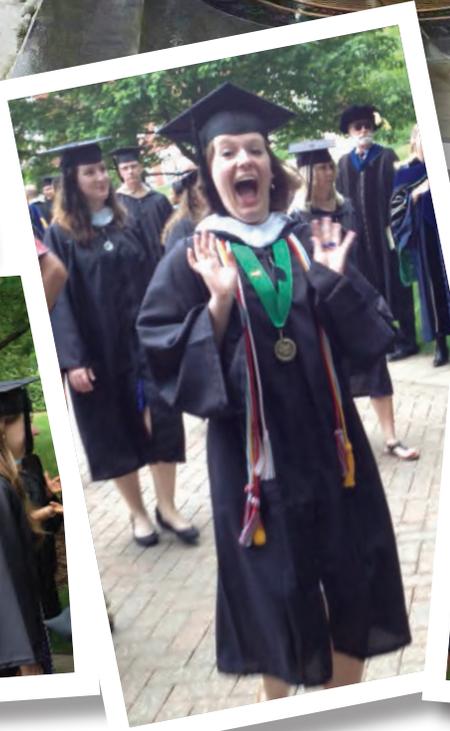
Marie Sheckels gave several external presentations this year, including “Lessons Learned: A First Attempt at Using a Flipped Classroom Model” at the Joint Mathematics Meetings in Baltimore.

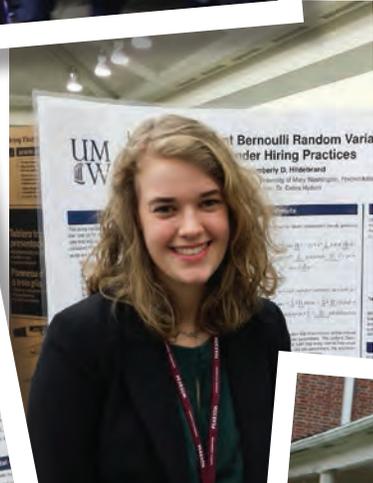
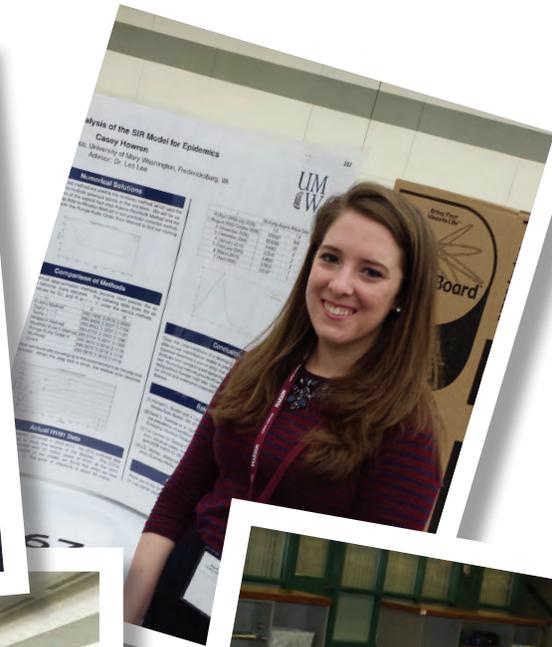
Suzanne Sumner presented a poster on the ‘Race and Revolution’ First-Year Seminar, with Mary Beth Mathews, at the Lilly Conference in Bethesda, MD. She was also re-elected President of the Beta Eta Chapter of Delta Kappa Gamma, an international honorary society for women educators.

Are you a member of our Facebook group?
Look us up – UMW Mathematics – and join today!

Check out our website
– cas.umw.edu/math –
view our page devoted to our alumni and, better yet, email Dr. Helmstutler at rhelmstu@umw.edu to get yourself included!

Gallery





Alumni Notes

Sarah Reese '07 completed her Ph.D. in biostatistics from Virginia Commonwealth University in 2013 and is now in a postdoctoral position at the National Institute of Environmental Health Sciences at Research Triangle Park in North Carolina. Sarah also got married in June of this year, bought a new house, and added a new puppy to the family.

Jon Stallings '09 received his Ph.D. in statistics from Virginia Tech and is now an assistant professor at North Carolina State.

Gustavo Ramallo '09 now works as an examiner for the US Patent and Trademark Office.

Jamie Fletcher Winslow '06 and **George Winslow '07** are married and expecting their first child this year.

Jake Farinholt '09 published the paper "An ideal characterization of the Clifford operators" in the *Journal of Physics A: Mathematical and Theoretical*.

Sean Droms '07 completed his Ph.D. in low-dimensional topology at UVa in 2013. He just finished his first year as an assistant professor at Lebanon Valley College in Pennsylvania.

Sam Carolus-Hager '13 volunteered his time as bike mechanic for Cycle for STEM, a cycling tour raising funds for STEM Teaching Tools grants through corporate sponsorships and individual donations in support of tour cyclists. The group rode from Pittsburgh to Washington, DC over 6 days in July, stopping at various points along the way to hand out scholarships. The 2014 Cycle for STEM tour, organized by the Armed Forces Communications and Electronics Association, raised over \$50,000 for STEM grants.

