

Mathematics at UMW

Fall 2013

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

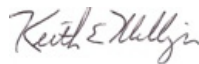
Welcome from the Chair

It occurred to me as I was preparing this year's newsletter that I just completed my 10th year at UMW. Some of you reading this newsletter may remember when I arrived at UMW (then MWC) in the fall of 2003. Since then, the department has continuously evolved, and this past year was no exception. We had a healthy crop of honors students and summer science researchers this past year and you can read about their many accomplishments in this newsletter. Many of our graduating students found gainful employment after graduation and some are in graduate programs. We try very hard to stay in touch with our alumni. There is a section of our website devoted to them, and Facebook has been valuable for keeping us in touch (join our group!). So, please, if you're a graduate of our department, please let us know how you've been and where your life has taken you.

This fall we welcome two new faculty members to the department. You can read more about Melody Denhere and Jennifer Magee in this newsletter. Our new advanced course Theory of Interest goes on the books this fall and will support our emerging minor in Actuarial Science. Down the road, a

minor in Statistics is also planned. The UMW campus is also changing. Chandler Hall is gone, torn down after graduation this past spring. A new student center will be built in its place while the Department of Psychology moves to a renovated Mercer Hall, and the College of Business faculty move to Woodard. Soon we will see the Convergence Center come on-line as its construction is in the final stages.

As always, I hope you enjoy reading about what has been happening in the department over the last year. I am very proud of the accomplishments of our faculty and students. We have indeed set a high bar for ourselves. Finally, I want to thank everybody for their support during my time as the department chair. This year marks my final year as chair. I took over for Debra Hydorn back in the spring of 2008 and I have decided that it is time for me to pass the reins. Best wishes and do stop by to see us sometime.



Keith E. Mellinger, chair

Welcome to Melody Denhere and Jennifer Magee



The Department of Mathematics is pleased to welcome two new faculty members this fall. First is Dr. Melody Denhere, a native of Zimbabwe, who completed her doctoral studies in Mathematics at Auburn University in Auburn, Alabama this past summer. She also holds a Master's in Applied Mathematics from Auburn University (2010) and a Master's in Computer Science from the University of Zimbabwe (2007). Her area of research is statistics and she's currently working in the field of functional data analysis, an emerging field in statistics. Her other interests in Statistics include statistical education, bio-statistics and robust statistical methods. Outside of Statistics and Mathematics, Melody enjoys traveling to different parts of the world, playing tennis and is also keen on playing the guitar.

Also joining us this fall is Jennifer Magee, who starts as a full-time lecturer. Jen recently earned her Master's degree in mathematics from Bowling Green State University in Bowling Green, Ohio. Prior to that, she studied mathematics and economics at Washington & Jefferson College in Washington, Pennsylvania. Her mathematical interests lie primarily in algebra, and she is excited to begin her teaching career at UMW this fall. Outside of the classroom, Jen enjoys baking, playing board games, and reading, and is looking forward to getting married in May.



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where great minds get to work

Honors 2013



Four of our students defended the work in their honors theses in the spring of 2013. In **Morgan Brown's** honors thesis, completed under the direction of Dr. Leo Lee, she used computational approaches to construct a numerical wave equation model both in one and two dimensions. She used Taylor series expansions and truncations of functions in her model, derived numerical algorithms to determine the solution, and developed computer simulation programs to approximate the behavior of waves in natural phenomenon such as waves in strings and trampolines. She also constructed a general matrix that can be used to obtain numerical approximations to the wave model in any finite-dimensional solution space, which is her main result. She now works for the Naval Surface Warfare Center at Dahlgren as an intern, and she is returning to UMW to complete her senior year of studies.

Peter Slattery, also advised by Dr. Lee, considered an analytical approach for solving the wave equation in both one and two dimensions. He used the method of separation of variables, the method of eigenfunctions, and Fourier series expansions to derive the exact solution to his model equation. He also wrote his own computer codes to visualize the behavior of waves in real-world physical examples that could be modeled using the wave equation. He has received offers of acceptance from several universities with the potential for some financial aid, and he plans to study more advanced mathematics in a graduate program.

Kelly Brown started her honors project in the fall of 2012 under the direction of Dr. Suzanne Sumner. In

her honors thesis, she extended a model of honey bee colony population decline to include a hive bee per capita death rate and more realistic parameter values. She derived criteria for the existence of a globally stable positive equilibrium, and she found a threshold level for determining when colony failure becomes inevitable due to declining population sizes. In addition, Kelly modified Mathematica code to produce phase portraits of her model as parameters change. In November 2012, Kelly was invited to present her research for the Biomathematics Seminar at Virginia Commonwealth University. Since graduation, Kelly has been working as an Associate Developer/Systems Engineer on a network development team at SWIFT Technology Center in Manassas, Virginia.

Finally, **Kathryn Dillinger's** honors thesis, directed by Dr. Lee, utilized the heat equation with a heat source term to measure the temperature of filaments from various light bulbs. She also attained three different numerical models by using difference equations, computed actual filaments' temperatures using physics, developed computer codes for each of her models to find the most accurate numerical models, and gave comparisons between the physical, analytical, and numerical temperatures. She has been working for the Naval Surface Warfare Center at Dahlgren as a mathematician since June 2013.

Study in Budapest

by Ryan Vaughn, class of 2013

In the fall of 2012, I studied abroad in Budapest, Hungary, as part of the *Budapest Semesters in Mathematics* program. Through this program, I was given the chance to study advanced math courses abroad while experiencing life in Europe. It was an amazing opportunity, and changed my life both culturally, and mathematically.

Hungary is a country in Central Europe known for its strong tradition in mathematics. The Budapest Semesters in Mathematics program was founded based on this tradition, and offers advanced mathematics courses in English. I took classes in Advanced Abstract Algebra, Modern Geometry, and Combinatorics. Although the program differs from standard study abroad programs in that it is typically much more difficult than courses at home, there was still plenty of time to explore the city and surrounding area.



Culturally, the experience of living in a foreign country forever changed my life. Hungarian is known to be one of the hardest languages to learn for English speakers, but for the most part everyone in Hungary speaks at least a tiny bit of English. Since the program had 70 or so American students, we became a very close-knit group, spending lots of time together exploring Budapest and the surrounding area.

During my time in Budapest, I had the chance go on many adventures. Budapest is a common tourist destination in Central Europe, and there were festivals nearly every weekend. I also had the chance to travel to spend a weekend in a resort town in Hungary. Many others in the program also traveled to neighboring cities like Vienna, Munich, and Brussels.

Overall, I had an amazing time traveling to Budapest. I would recommend the program to any junior or senior who has already completed all or nearly all of the UMW major requirements, and wants to continue taking advanced classes. If any student is interested, get in touch with the faculty early to see what resources are available to you. Although taking such intense classes in a foreign country did have its stresses, I will always cherish the memories I have of studying abroad.



Summer Research

As part of UMW's Summer Science Institute of 2013, **Casey Howren** analyzed a mathematical model of communicable diseases describing the susceptible, infected, and recovered populations under the direction of Dr. Leo Lee. Her project was titled *The S I R Model for Evaluating the Impact of Epidemics on a Population*. In her project, she derived the exact solution for the model under some appropriate assumptions, developed an algorithm using Euler's Method, and wrote the corresponding computer code to compute numerical solutions. Also, she applied her method to real world data in order to model the behavior of H1N1, as well as polio and HIV. Her work seeks to show that using mathematical methods to model epidemics can accurately predict the behavior and severity of a disease.

Katie Jones and **Kyle Genovese** worked with Dr. Julius Esunge on projects in applied statistics. The statistical tools of multiple regression and principal component analysis were introduced to the students, alongside the proper organization of data, and the use of the R software. Thereafter, these techniques were applied to different sets of data, to model economic growth in developing countries, analyze total energy consumption in the USA, and to study nationwide individualized education plans.

Dane Lawhorne spent his summer studying the digital line and digital circles with Dr. Randall Helmstutler. These topological spaces have been known to computer scientists since the 1970s, who used them as discrete or "pixelated" versions of the real line and unit circle. Dane proved that although the digital line is countable and digital circles are always finite, they still share many of the

same properties and relations as the ordinary real line and circle. For instance, the symmetry groups of the digital line and the real line have related algebraic structures, and all the relations between the real line and circle found in homotopy theory carry over to the homotopy theory in the digital cases. Dane and Dr. H. plan to travel to Longwood University to present Dane's work at the sectional meeting of the MAA in November.

Kimberly Hildebrand worked with Dr. Debra Hydorn to examine gender bias in hiring practices. The number of women hired for a fixed number of positions was modeled using the sum of independent Bernoulli random variables, each with a different proportion of female applicants. The proportion of female applicants for each position was modeled using a series of different Beta distributions, with the average proportion of women less than, equal to, or more than the proportion of men. Kimberly derived the expected value and variance for the number of women hired and the probability that one or fewer women are hired. She wrote a program in R to run simulations which she compared to the results for the Binomial distribution. Her results suggest that when the average proportion of female applicants is around 0.60 the probability that one or fewer women is hired is around 15% but when the average proportion of women applicants is around 0.40 the probability that one or fewer women is hired is around 2%. Depending on the proportion of female applicants for a given situation, these results could be used as evidence to support a gender bias in hiring practices.

NSF Grant Update – Precalculus Activities, Peer Mentoring and High School Outreach Research

Several projects supported by the 2011 NSF STEM (Science, Technology, Engineering and Mathematics) Talent Expansion grant have involved mathematics faculty and students. To help students make connections between mathematics and science, Dr. Suzanne Sumner created five data collection activities for MATH 111: Precalculus. The activities use probes that attach to TI calculators to collect data for students to study mathematical models. Dr. Sumner created the activities, working with Dr. George Meadows in the College of Education, during



the summer of 2012. Research on how students learn indicates that peer mentors can be effective in increasing students' interest and success in STEM disciplines. As part of the NSF grant two students served as leaders in the Peer Assisted Study Sessions (PASS) associated with MATH 121: Calculus I and MATH 122: Calculus II during the 2012-2013 academic year, working under the direction of department faculty. Students **Karissa Herrick** and **Kylie Kerr** each offered approximately three hours of study sessions each week. Student feedback indicates that they found the sessions helpful, and the department will be offering PASS sessions again next year. As part of the grant's Summer Outreach Initiative Dr. Esunge mentored two high school students with his 2012 Summer Science Institute students. The high school students joined Dr. Esunge's research team half way through the SSI program to work on a project to model economic growth in developing countries and US energy consumption. The high school students assisted with data collection and sorting, and with running programs using R to generate regression output to be analyzed by the entire team.

Keith Mellinger wins Alumni Award



At the spring honors and awards convocation at Millersville University of Pennsylvania, Dr. Keith Mellinger, Chair of the Department of Mathematics at UMW, was awarded the Young Alumni Achievement Award by the MU Alumni Association. The award recognizes baccalaureate graduates of the last 20 years identified as being outstanding in their professions or careers. Mellinger is a '95 graduate of Millersville University where he majored in mathematics with a minor in computer science.



Caroline County Grant

During 2012-2013, Dr. Suzanne Sumner worked on a STEM grant partnering UMW with Caroline County Public Schools for a Virginia Department of Education's 21st Century Community Learning Centers grant. In May 2013 she organized two professional development workshops with the theme of energy for Caroline County middle school teachers featuring UMW science and mathematics professors. Pictured on the left is Dr. Melanie Szulczewski in Earth and Environmental Sciences leading a workshop on solar cooking. UMW students **Yeji An** (also pictured), **Marc Dellacanonica**, and **Michael Hudick** worked with the grant as interns for the Caroline Middle School after-school program where the middle school students developed their mathematics, science, and literacy skills using project-based learning.

Faculty Highlights

Many faculty in the department published articles in scholarly journals this year. **Yuan-Jen Chiang** had her article "f-biharmonic Maps between Riemannian Manifolds" published in the *Journal of Geometry and Symmetry in Physics*. **Janusz Konieczny** published three articles this past year. His article "Centralizers in the full transformation semigroup" appeared in the journal *Semigroup Forum*, and "Sn-normal semigroups of partial transformations," coauthored with alumni **Sean Droms** and **Roberto Palomba**, appeared in *Algebra Colloquium*.

In addition, **Larry Lehman** saw his article "Suborder Polynomials Modulo Primes", appear in the *JP Journal of Algebra, Number Theory, and Applications*. **Leo Lee** published "A Stochastic Galerkin Method for Stochastic Control Problems" in the interdisciplinary journal *Communications in Computational Physics*, and **Keith Mellinger's** article "Blocking semiovals containing conics" appeared in the journal *Advances in Geometry*.

National and international travel to conferences was also popular this past year. **Julius Esunge** was in Buea, Cameroon, to present at the *Summer School and Conference on Financial and Actuarial Mathematics*, and **Yuan-Jen**

Chiang traveled to Shanghai, China, in June to present her work at the 2nd Pacific Rim Mathematical Association Congress. Leo Lee gave presentations at conferences in Los Angeles, CA, Ames, IA, and at Ajou University in Korea, and **Keith Mellinger** traveled to London, England, to give a talk at the *24th British Combinatorial Conference*. **Suzanne Sumner** participated in a special session on *Communicating Mathematics* at the Joint AMS-MAA Meeting in San Diego, CA.

Larry Lehman presented his recent research results at the MD-DC-VA Section Meeting of the Mathematical Association of America, at Virginia Military Institute. Debra Hydorn traveled to Orlando, FL, to present her research at the 9th INTECOL International Wetlands Conference: Wetlands in a Complex World, and **Randall Helmstutler** and **Keith Mellinger** presented at the COPLAC Summer Faculty Institute on Liberal Learning in the Disciplines held at the University of North Carolina – Asheville. Their presentation discussed the student-centered learning and high expectations that have been cultivated in the department at UMW over the years.

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. Mellinger at kmelling@umw.edu to get yourself included!

Gallery







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