

Mathematics at UMW

Fall 2010

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

Welcome from the Chair

Dear Friends,

I would like to welcome back all of our faculty and students to another academic year. This is always an exciting time as we welcome back our majors, anticipate new majors, and start thinking about activities for the coming year. Plans are already under way for the department to bring in a few outside speakers, and in collaboration with a few other departments, we are welcoming world famous economist and mathematician Dr. Herbert Gintis, who is UMW's Phi Beta Kappa visiting scholar this year.

Changes continue at UMW. Here in Trinkle Hall we have new furniture and many new computers throughout our classrooms. The campus continues to see major construction. Lee Hall is officially open for all student services, Monroe Hall is on schedule to reopen in the summer of 2011 after a year of being off-line, and a couple of the dormitories are being taken off-line this fall as the campus continues to upgrade and renovate our existing facilities. Eagle Landing, the mixed-use residential and retail complex adjacent to Giant across route 1, is now complete and will provide residence space for over 600 of our students. In addition, several new eateries and stores will be opening in the new space later this fall.

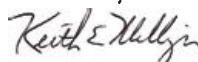
The department continues to evolve as well. Last spring, the department offered a 400-level course in partial differential equations, and this fall a course in financial mathematics is overloaded with students. Complex variables, topology, abstract algebra, and real analysis continue to run annually, and topics courses like the ones listed above really complement our program. The department has made efforts to offer more and varied courses at the 400 level in order to better meet the needs of our students, and it seems that things are paying off. Our students are having great success both with admittance to graduate programs and in the private sector.

In previous years I have been very impressed with the accomplishments of our students, and the past year has been no exception. Four students graduated with honors

in 2010, others participated in the summer research program, and two were awarded prizes at professional conferences. In addition, several of our majors have had articles accepted for publication in respected journals. All of this activity of our students continues to promote the excellence of our department.

I hope you enjoy reading about the department's activity this past year. As usual, please do not hesitate to contact me if you believe we can be of service to you.

Sincerely,



Keith E. Mellinger, chair

Joyce Durham celebrates 25 years



Ms. Joyce Durham surrounded by the former and current department chairs

Many of you know Joyce Durham, the office manager for the department. This year Joyce was recognized for 25 years of service. She has certainly been a valuable and very reliable member of our department and we are continually thankful to her for all that she has done for us. Thanks Joyce!

Honors in Mathematics 2010



Elizabeth Bernat and Dr. Leo Lee

Several of our majors wrote theses and graduated with honors this past year. **Elizabeth Bernat** worked on a project titled *Analysis of Temperature Change Using a Mathematical Model* under the direction of **Dr. Leo Lee**. In her project that was extended from her 2009 SSI project, Liz used a mathematical model to analyze temperature changes in a rectangular

region. She solved the model mathematically and computationally, and she proved the convergence of her numerical method. She also presented numerical results for her model so that she could see how the temperature changed as she altered the input data. Liz applied to the U.S. Student Fulbright Program and, as a result, she starts a graduate program this fall in economics at the University of Helsinki in Finland.



Dr. Debra Hydorn and Sarah Ball

Under the direction of **Dr. Debra Hydorn** and Dr. Robert Rycroft (Department of Economics), **Sarah Ball** completed the first joint mathematics and economics honors project *Estimating Mean Willingness to Pay for the Success of the Blue Crab in the Chesapeake Bay*. For this project she researched the design of surveys to estimate mean willingness to

pay (an economic quantity designed to measure an individual's propensity to contribute toward community and social programs), conducted the survey on campus in a variety of lower and upper level courses

across campus, and she investigated the use of logistic regression analysis to evaluate her survey results. As a double major in mathematics and economics Sarah had previously studied a variety of statistical methods but her previous course work and undergraduate research projects did not involve logistic regression, which creates a model for a dichotomous dependent variable based on a collection of qualitative and quantitative independent variables. Sarah is beginning her first year in Agricultural and Resource Economics at the University of Maryland this fall.



Dr. Randall Helmstutler and Barbara Brown

Barbara Brown's thesis, *Generalized Dihedral Groups of Small Order*, was written under the direction of **Dr. Randall Helmstutler**. Barbara's project stemmed from an attempt to extend the construction of the dihedral groups (a standard topic in an undergraduate abstract algebra course) to a larger class of groups. In her thesis she gives complete details on

how to construct these generalized dihedral groups, along with numerous results on their algebraic structure. Barbara was also able to identify the isomorphism type of each generalized dihedral group of order 50 or less. Barbara presented her work at the SUMS conference at James Madison University in October 2009.

Finally, for his honors project, **Thomas Wolfe** worked with **Dr. Debra Hydorn** to analyze data collected by colleagues of Dr. Deborah Zies in the Biology Department on the incidence of various genetic mutations among individuals with Smith-Magenis syndrome. Because the data set involved identifying associations between a list of mutations and a very large number of physical characteristics Thomas investigated the use of Canonical Correlation Analysis (CCA) to identify potential mutation-characteristic associations. An underlying assumption for using CCA is that the data follows a multivariate normal distribution. Because

–Continued on page 3

Honors

–Continued from page 2

this data is categorical Thomas also investigated methods for “normalizing” the data. The pairs of associated variables identified through CCA were further studied using traditional chi-square analysis methods. This fall Thomas will begin his first year in the Bioinformatics Ph.D. program at the University of Michigan (which happens to be the school where Dr. Hydorn earned both her bachelor’s degree and Ph.D.).



Thomas Wolfe and
Dr. Debra Hydorn

Summer Enrichment for High School Students

In 2010, UMW started its first ever summer academic program for talented high school students, and the department of mathematics played a major role. Drs. Esunge, Helmstutler, Hydorn, and Mellinger each developed week-long intensive courses on topics like random processes, problem solving, cryptology, and the relationship between mathematics and the visual arts. The non-residential intensive curriculum offers secondary-school students the opportunity to pursue their interests under the guidance of seasoned instructors who have worked for many years with high-school and college classes. Students gain both solid academic experience and exposure to campus life, instilling them with the much-needed motivation that comes along with immersion in a highly respected college learning environment. The program is still in its infancy and we look forward to continuing to offer courses to help meet regional demands. Please see www.umw.edu/sep for more information on offerings for summer 2011.

Mellinger wins MAA’s Allendoerfer Award



Dr. Keith Mellinger

At Mathfest 2010, Dr. Keith Mellinger and his coauthor Dr. Ezra “Bud” Brown from Virginia Tech were awarded the Carl B. Allendoerfer Award from the Mathematical Association of America. Here’s an excerpt from the MAA’s official announcement:

“Kirkman’s Schoolgirls Wearing Hats and Walking Through Fields of Numbers”

The historical basis for this interesting article is a problem in recreational mathematics posed by T. P. Kirkman in 1850. Kirkman’s problem states:

“Fifteen young ladies of a school walk out three abreast for seven days in succession: it is required to arrange them daily so that no two shall walk abreast more than once.”

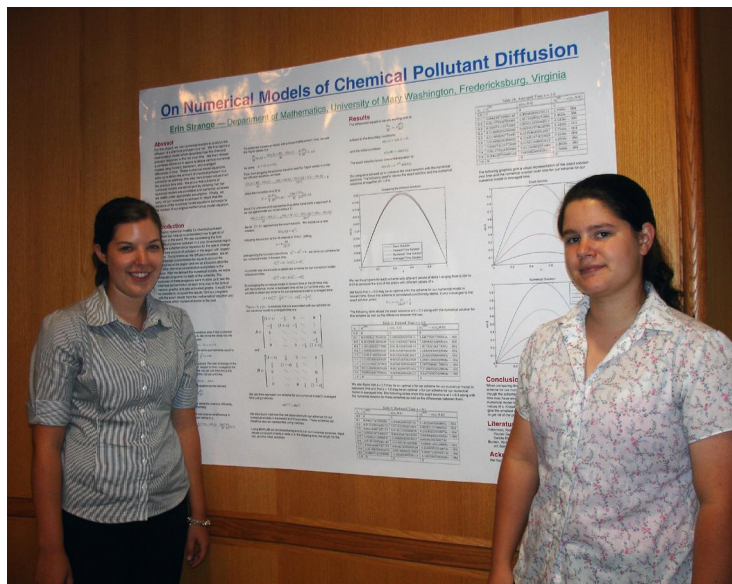
Using this problem as a springboard, the authors treat the reader to a captivating exploration of the theory and applications of block designs. In the process, solutions to the schoolgirls problem are uncovered in such seemingly unrelated areas as the subfield structure of algebraic number fields and the configuration of “spreads” and “packings” in finite projective geometry.

This well-written and accessible article invites the reader to join the authors on a fascinating journey into the modern theory of block designs and the surprising connections of these designs to diverse areas of mathematics. Readers who accept the invitation will be left with both a deeper understanding of Kirkman’s problem and an appreciation of the ubiquitous nature of its solution.

**Check out MaryWashMath
on flickr.com to see department
pix from the last 6 years!**

Summer Science Institute 2010

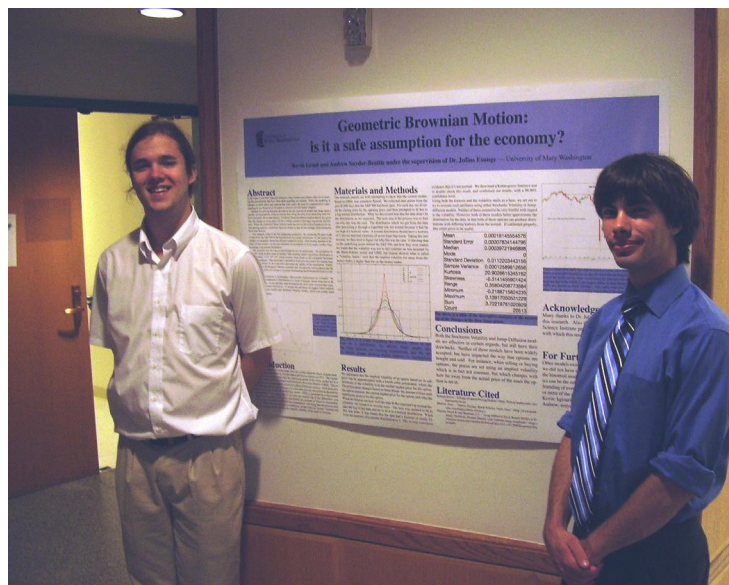
Two research teams participated in the Summer Science Institute this past year, researching topics in applied mathematics. First was the team of Erin Strange and Teresa Yao who worked with Dr. Leo Lee.



Erin Strange and Teresa Yao

Teresa's project was titled *Concentration of a Chemical Pollutant Modeled by a Fourier Series*. She worked on analyzing equations modeling the diffusion of a chemical pollutant in one and two dimensional regions. Based on given input data such as initial and boundary conditions, she derived the Fourier series—that is, a combination of infinite sums of sine and cosine terms—that models the solution of the equation in both one and two dimensional regions. She then developed computer programs to simulate each Fourier series in different dimensions.

On Numerical Models of Chemical Pollutant Diffusion was the title of Erin's portion of the project. She used numerical models to analyze the diffusion of a chemical pollutant in a rod. She first derived a mathematical model that describes how the chemical pollutant disperses in the rod over time. She then derived three different numerical models using a centered difference in space and forward, backward, and averaged differences in time, respectively. After she derived the numerical models, she wrote computer programs for each model to see the chemical concentration at each time step in the form of vectors, graphs, and animated graphs. Finally she



Kevin Groat and Andrew Snyder-Beattie

compared her numerical output with the exact output from the mathematical equation and determined which numerical model was best.

Andrew Snyder-Beattie and Kevin Groat worked with Dr. Julius Esunge on a project dealing with financial markets. On the heels of the recent global financial crisis, this project sought to examine the leading model for pricing of financial derivatives and expose the students to the underlying mathematics. Actual data from traded securities was examined within the context of the Black-Scholes pricing mechanism with a view to deciding how well this data follows the model.

The conclusions of this 10-week study were presented to SSI participants and faculty at the closing symposium at UMW and also at the summer meeting of the Mathematical Association of America in August in Pittsburgh, PA. The title of their presentation was "Geometric Brownian Motion, a Safe Assumption?" At both gatherings, the project received a commendation for "outstanding presentation."

Are you a member of the alumni group on Facebook? Look us up – UMW Mathematics Alums – and request to join today!

Faculty Highlights

Several faculty published articles in refereed journals this year. These include the article by **Janusz Konieczny** titled “General Theorems on automorphisms of semigroups and their applications” published in the *Journal of the Australian Mathematical Society*, **Yuan-Jen Chiang**’s article “Biwave maps into manifolds” which appeared in the *International Journal of Mathematics and Mathematical Sciences*, and an article by **Keith Mellinger** titled “2-dimensional optical orthogonal codes from Singer groups” which appeared in the journal *Discrete Applied Mathematics*. Finally, **Julius Esunge**’s article “A Class of anticipating linear stochastic differential equations” appeared in the journal *Communications on Stochastic Analysis*.

We also saw progress on several articles with UMW student coauthors this year. They include “The structure of endomorphism monoids in conjugate categories” written by **Randall Helmstutler** and former mathematics major **Roberto Palomba**, now a graduate student in NYU’s financial risk engineering program, which appeared in the *International Journal of Algebra*. “LDPC codes arising from hyperovals” written by recent graduates **Katie Hunsberger** and **Catherine Castleberry**, with **Keith Mellinger** as a coauthor, appeared in the *Bulletin of the Institute of Combinatorics and its Applications*. Also, the article “Recursive sequences and polynomial congruences” authored by **Larry Lehman** and alumnus **Chris Triola**, now a physics graduate student at The College of William and Mary, was accepted to the journal *Involve*.

In the summer of 2009, **Randall Helmstutler** led a week-long problem-solving seminar for the Commonwealth Governor’s School, and in December, **Suzanne Sumner** gave a keynote presentation “Why is it a good idea to study math?” for the Mu Alpha Theta national honor society at Mountain View High School in Stafford. **Leo Lee** traveled to North Carolina in July to attend the GCAT (Genome Consortium for Active Teaching) Synthetic Biology Workshop with Dr. Theresa Grana of UMW’s Department of Biology, and **Marie Sheckels** is serving as an external evaluator for the grant “Enhancing Mathematics Achievement in Middle School Students” that Stafford County received. The grant paid for equipping classrooms at two of the county’s middle schools with Smart Boards. Dr. Sheckels will be looking

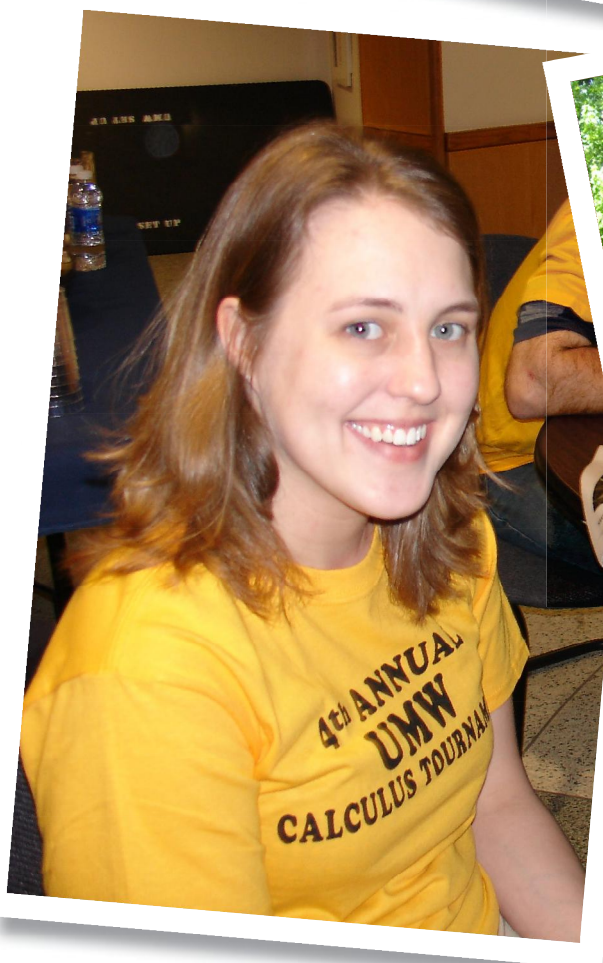
at how the project is delivered and what impact the new technology has on the middle school students’ scores on the SOL mathematics tests. The MAA’s professional development program *Project NExT* welcomed **Julius Esunge** to the program this academic year. Dr. Esunge had a busy summer being invited for a 2-week visit to the Institute of Mathematics and Applications at the University of Minnesota.

Many of the faculty have delivered professional presentations in a variety of venues. **Yuan-Jen Chiang** presented “Harmonic Maps and Biharmonic Maps” at a Department of Mathematical Sciences colloquium at George Mason University, and **Keith Mellinger** spoke on “Classes of permutation arrays in finite projective spaces” at the *International Conference on Designs, Codes and Geometries* in Lewes, Delaware. **Leo Lee** traveled to Korea in December to give the invited talk “Error Estimates of Stochastic Optimal Neumann Boundary Control Problems” at the joint meeting of the Korean and American mathematical societies. While in Korea, Dr. Lee visited several other universities, each time delivering invited talks about how we use mathematics to solve real-world problems. Last fall, **Julius Esunge** traveled to Hammamet, Tunisia, to speak at the *International Conference on Stochastic Analysis and Applications*.

In July, **Debra Hydorn** gave an invited presentation on *Combining On- and Off-Campus Service Learning in a Statistics Methods Course* at the 8th International Conference on Teaching Statistics in Ljubljana, Slovenia. In addition, Dr. Hydorn gave a presentation on using blogs in FSEMs with **Suzanne Sumner** at the *International Conference on Technology in Collegiate Mathematics* in Chicago. Dr. Sumner was invited by Howard University to give the seminar presentation *Mathematical Modeling of Data describing Worker Bee Aggression towards a Foreign Queen* in Washington, D.C. and gave a shortened version for the Biomathematics, Modeling in Biology, Ecology and Epidemiology session of the Joint Mathematics Meeting in San Francisco, CA, last January.

Check out our new website
– www.umw.edu/cas/math –
view our new page devoted to our alumni and,
better yet, Email Dr. Mellinger at
kmelling@umw.edu to get yourself included!

Gallery







Department of Mathematics
1301 College Avenue
Fredericksburg, VA 22401-5300

Non-Profit Org. U.S.
Postage
PAID
Permit No. 227
Fredericksburg, VA

