

Mathematics at UMW

Fall 2009

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

Welcome from the Chair

Dear Friends,

I would like to extend a warm welcome to our new students entering UMW this year. The Department of Mathematics is excited to be providing more freshmen advisors because of the larger number of students expressing an interest in studying mathematics with us. Additionally, we are very happy to welcome Dr. Julius Esunge, who joins the department this fall as an assistant professor. Dr. Esunge brings expertise in both applied mathematics and statistics. We are excited to have such a qualified individual join the department, and you can read more about him in this newsletter.

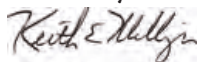
Last spring we saw the departure of Dr. Jeff Edmunds, who resigned after eight years of service to UMW. Dr. Edmunds was very active in starting our undergraduate research program and in developing our applied mathematics curriculum. He will be missed by all.

Trinkle Hall is continuing to change every year, it seems. This summer, major renovation occurred in the basement where the entire north hallway was reconfigured. The end result is two much larger and more versatile classrooms, a new mathematics computing lab,

and two very nice computer lab spaces for use by the Department of Computer Science. In addition, room B36 has been converted to a “model classroom” for use by the Department of Education.

I continue to be impressed with the quality of our program here at UMW. Last year we had an unprecedented *six* students complete honors projects in mathematics, more than any other year in the past, and we are seeing more and more students being recognized both regionally and nationally for their work. We see our students leaving us with prospects of graduate school or highly successful career paths in industry. It is a healthy time to be studying mathematics with us, and we look forward to continuing our tradition of providing the highest quality program for our students. Please do not hesitate to contact me if we can be of service to you, and best wishes as we move into fall 2009.

Sincerely,



Keith E. Mellinger, chair

Students Winning Awards

Our students have been busy representing the department both regionally and nationally, winning awards for their projects. At the Joint Mathematics Meeting in Washington, D.C., last January, then-junior **Thomas Wolfe** won the Student Poster Award for Excellence in Statistics. His poster detailed the results of his summer project, sponsored by UMW's Jepson Summer Science Institute. The project was titled *Modification and Investigation of the Akaike Information Criterion for Models in the Natural Log of Y* and was completed under the direction of Dr. Debra Hydorn



Thomas Wolfe

At the Jepson Summer Science Symposium this year, we were very happy to have **Barbara Brown** recognized for *Best Presentation*. This is only the second time that a mathematics student has won an award at this annual event. Barbara's project, titled *Generalized Dihedral Groups*, was completed under the direction of Dr. Randall Helmstutler.



Barbara Brown

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Awards

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Billy Ella

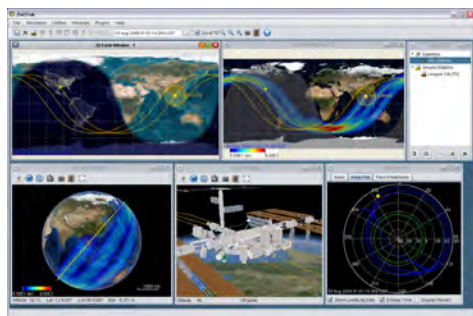
Finally, senior **Billy Ella** was honored at the spring regional meeting of the MAA for his work with Dr. Helmstutler, titled *Retracts in Category Theory*. This work was part of Billy's honors project in mathematics, and the award is given to only one student at each regional meeting.

Internships at Dahlgren

The Naval Surface Warfare Center at Dahlgren employs students every year as interns. Our mathematics students have had a tremendous amount of success there, both as interns and as employees.

This summer **Tommy Wolfe** worked at Dahlgren Naval Research Station investigating some new software for the Warfare Department. That department is working to switch from a highly expensive program called Satellite Tool Kit to an open source, free program called World Wind Java (much like a simpler version of Google Earth) that has been developed by NASA. Tommy's job this summer was to code applications to World Wind Java that will replicate the scenarios for which the department now uses Satellite Tool Kit. They generally use Satellite Tool Kit to model GPS satellites and missile paths.

Tommy was successful in implementing satellite and missile models along with their trajectories into World Wind Java. His research was so successful that he believes



A screen shot of Tommy's work at Dahlgren

the Warfare Department will switch from Satellite Tool Kit to World Wind Java and save the department more than \$20,000 a year.



Julius Esunge

Welcome to Julius Esunge

The department is very excited to welcome Dr. Julius Esunge to UMW. Julius hails from Cameroon. He holds a doctorate in mathematics from Louisiana State University in Baton Rouge, Louisiana. His research is in stochastic analysis, a branch of mathematics that studies the behavior and

applications of random processes. He also holds a master of science degree in statistics from Lehigh University in Bethlehem, Pennsylvania. Julius is interested in many area of mathematics, including actuarial science, and we are eager to use his expertise to further develop our program. On a more personal note, Julius loves to jog and will be looking to find a route comparable to his four-mile loop around the LSU campus. He and his wife Eunice have two young children, Timothy and Lydia.

Honors in Mathematics 2009

2009 was a blockbuster year for our seniors, with an unprecedented six students graduating with honors in mathematics. First was **Christine Exley**, a double major in mathematics and economics and one of UMW's Washington scholars. Christine's thesis *Cryptography Based on Determining Sets* was written under the direction of Dr. Mellinger. In it, Christine looked at the



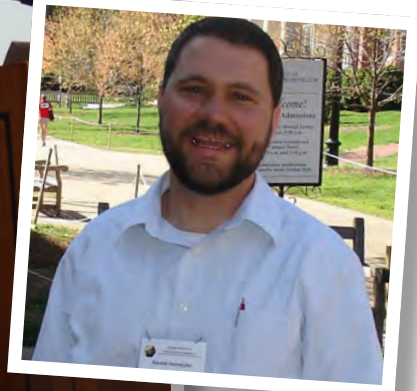
Keith Mellinger and Christine Exley

construction of collections of points called determining sets. Such sets can be found in non-Euclidean geometries, like projective planes, and are used as the key for a known patented

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UMW Hosts the Regional Meeting of the MAA

In April, Mary Washington hosted the spring meeting of the MD-DC-VA Section of the Mathematical Association of America. The conference brought roughly 170 faculty and students from all over the region to UMW for the two-day meeting. There were invited talks, multiple parallel sessions for contributed talks, a student Jeopardy tournament, a student paper competition, and lots of time to socialize with colleagues in the region. Here are some pictures from the event.



Dr. Hydorn Wins Topher Bill Award

At the opening faculty meeting in the fall of 2008, Dr. Debra Hydorn was honored with the J. Christopher Bill Award, which recognizes extraordinary service. This award is not for the normal, high level of faculty involvement in committee service and department leadership.



Debra Hydorn

Instead, it recognizes faculty who have gone beyond the expected, and Dr. Hydorn has certainly done that through her willingness to assist faculty and students in other departments, as well as her involvement at many levels in the local community.

For many of her years at Mary Washington, Dr. Hydorn has been a leader in the area of service learning and has guided her students' involvement in survey development and data analysis for a variety of local organizations: Hope House, the Rappahannock Council Against Sexual Assault, the Moss Free Clinic, the Fredericksburg Area Council of Youth, and the Friends of the Rappahannock, just to name a few. In addition, she has served as a statistical consultant on projects for organizations such as the Spotsylvania County's Mentor Teacher Program, the Lake Anna Watershed Roundtable, Fort AP Hill, and the Salvation Army. Virtually every demographic on campus, from students, to faculty members, to committees, to administrators, has benefited from her statistical expertise, and the department would like to congratulate her on this well-deserved honor.

Teaching with the TI-Nspire

In August, the Department of Mathematics at UMW hosted a regional Texas Instruments workshop focused on their new handheld technology, the TI-Nspire. The technology is an integrated system that combines learning handhelds and computer software with assessment tools that gauge student understanding within an interactive classroom.

The first two days of the workshop, *Getting Started with the TI-Nspire*, focused on basic use of the technology, and the last three days, *Using TI-Nspire in Your Classroom*, explored how to successfully integrate the technology into the high school curriculum at all levels.

The workshop was run by Elizabeth Coker, a teacher at Oscar Smith High School in Chesapeake, Va., and Angela Hoopes, mathematics department chair at Spotsylvania High School, both of whom are technology instructors for Texas Instruments. The

workshop is part of TI's program T^3 – *Teachers Teaching with Technology*, and it brought about 25 teachers from all around the state to UMW for the week-long workshop.

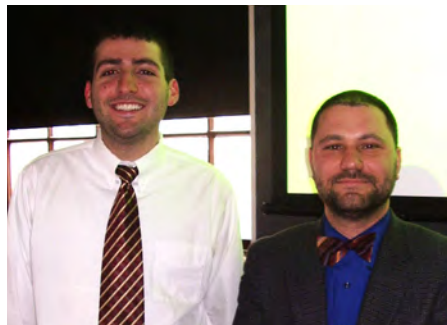


The new TI-Nspire with its powerful computer interface

Honors

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cryptographic protocol. Christine completed two internships during her time at UMW, and the second one, at the National Security Agency, is what sparked her interest in cryptography. She starts a graduate program this fall in economics at Stanford University in California.



Billy Ella and Randall Helmstutler

Next is **Billy Ella**, whose thesis *Retracts in Category Theory* was directed by Dr. Helmstutler. Billy's thesis looked at the notion of "retract" in the subject of topology, which is a kind of function that

preserves a portion of the underlying space. Billy learned the basics of category theory and then generalized the definition of retract to arbitrary categories. He next examined what this entailed in specific categories and used this to quantify their inherent structural differences. Billy's work won an award at the regional meeting of the MAA held at UMW in April. He is now in a doctoral program in mathematics at George Washington University.

Katie Hunsberger's thesis, titled *The Weight Enumerator for a Class of Codes Defined by Hyperovals*, was completed under the advisement of Dr. Mellinger. Katie looked at a class of linear error-correcting codes and used the techniques of finite geometry to characterize and count the small weight code words



Katie Hunsberger and Keith Mellinger

in the code. The arguments involved a healthy blend of discrete mathematics and algebra over finite fields, and her work relied heavily on her previous work on the same subject

(completed as part of the Summer Science Institute in 2008), which was recently accepted for publication in the Canadian journal *Bulletin of the Institute of Combinatorics and Its Applications*. Katie will be graduating with honors in December of 2009.



Jonathan Stallings and Debra Hydorn

Our next honors student, **Jonathan Stallings**, worked on a project titled *Improved Covariance Eigenvalue Estimates and Line Estimation* under the direction of Dr. Hydorn. For his honors project,

Jonathan extended the results from his 2008 Summer Science Institute project, for which he produced an improved confidence ellipse estimate of GIS coordinates using improved estimates of the eigenvalues of the covariance matrix of the coordinate variables (longitude and latitude). To produce an improved confidence band for a line estimate, Jonathan derived the distribution of the line between two points and compared the effectiveness of several methods for improving eigenvalue estimates for producing a line estimate. Jon heads to Virginia Tech this fall to begin a doctoral program in statistics.



Christopher Triola and Randall Helmstutler

Christopher Triola's honors project, *Special Orthogonal Groups and Rotations*, directed by Dr. Helmstutler, examined the interplay of abstract algebra with the geometry of flat

spaces. He was able to give a complete description of the group of length-preserving transformations of both the plane and three-space. This includes a thorough analysis of the possible eigenvalue behavior, together with an overview of the relation between eigenspaces and axes (or planes!) of rotation. Chris is now a doctoral student in physics at William and Mary.

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Honors

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Jake Farinholt and Keith Mellinger

Last but not least is **Jake Farinholt**, whose thesis *Designing Codes to Fit Your Needs* blended the applied area of coding theory with his interest in algebra and number theory. Under the direction

of Dr. Mellinger, Jake examined the construction of a class of codes known as BCH codes that are used to correct burst errors in applications like the compact disk. His work boiled down to a series of arguments involving cyclotomic cosets and relied heavily on the techniques of number theory. Luckily, Dr. Lehman was just down the hall, willing to help out. Currently Jake is employed at the Naval Base at Dahlgren and plans to start a graduate program in mathematics at George Mason this fall.

Summer Science 2009

The Department of Mathematics again participated in the Jepson Summer Science Institute, this time with three different research teams working in statistics, algebra, and partial differential equations.

Barbara Brown worked with Dr. Helmstutler on generalizations of the classical dihedral groups. These groups are known to model the symmetries of regular polygons, and Barbara examined ways of generalizing their construction in order to produce new groups with similar algebraic features. She was able to prove a structure theorem on the commutativity of such groups and computed many of these generalized dihedral groups of low order. She will continue her work in the fall as part of an honors project in mathematics. Barbara presented her work at UMW's Summer Science Symposium, where she won first place in the presentation category.

Dr. Lee's students **Kathryn Christian** and **Elizabeth Bernat** studied Laplace's equation, which describes heat

flow in equilibrium over a region. Kathryn worked on modeling heat conduction in a two-dimensional solid, which is one in which the same-shaped top and bottom surfaces are parallel and insulated, and the factors contributing to heat conduction do not depend on z-coordinates. She studied an exact solution obtained by the method of separation of variables and then created a computer program to calculate approximations for such solutions.

By contrast, Liz used the finite difference method to approximate solutions to Laplace's equation in order to find the temperature distribution over the interior of the same domain. After creating a code to run the numerical scheme, she verified that it produced results that were physically reasonable for the given boundary conditions. Both projects were very successful and the team traveled to *Mathfest* in Portland, Oregon, in August, where they presented their results.

Sarah Ball is majoring in both mathematics and economics. As a result, when Dr. Hydorn had the opportunity to work with Sarah this summer, she found a topic that would be of interest in both majors. Sarah worked on a project in regression analysis, investigating remedial methods for data sets with multicollinearity, or strong associations, among the independent variables. Sarah investigated a new method for the situation in which there are two highly correlated independent variables, which they are calling the "2 point" method. In this method two data points are added to the data set to stabilize the regression estimates while leaving the estimates basically unchanged. Sarah continues with us this fall and plans to graduate in May of 2010.



Participants in the 2009 Jepson Summer Science Institute

Faculty Highlights

Suzanne Sumner has been appointed to the Teaching Professor Conference Advisory Board. The Teaching Professor Conference is an international conference dedicated to promoting the best teaching practices in higher education. Dr. Sumner will help plan and organize upcoming Teaching Professor Conferences, and she will evaluate conference proposals. Dr. Sumner will be spending this fall on a much-deserved sabbatical leave, working on her project “Mathematical Modeling of Honey Bees” at Howard University in Washington, D.C.

Yuan-Jen Chiang had the paper “Transversally biharmonic maps between foliated Riemannian manifolds” published in the *International Journal of Mathematics*. In addition, she presented talks at both the Ninth Pacific Rim Geometry Conference at National Taiwan University last December, and at the Lehigh University Geometry and Topology Conference in Pennsylvania.

After many years of leg work, an entire sabbatical’s worth of serious writing in the spring of 2007, and a year’s worth of classroom testing, **Gary Collier’s** book *Analysis on Metric Spaces* is in its final stages. The result is a 160-plus-page book, adaptable to a one or two semester course in analysis, all written in Dr. Collier’s popular teaching style. The book is currently being examined by a publisher.

Our newest colleague, **Leo Lee**, gave an invited talk at the Applied Mathematics Seminar at the University of Delaware last spring. In addition, Dr. Lee attended an international U.S.-Korea conference in Raleigh, N.C., where he presented his recent results about solving stochastic control problems by the finite element method. We are looking forward to Dr. Lee offering a new 400-level course in partial differential equations this spring.

Debra Hydorn was active this past year developing a new first-year seminar, titled *Escher Math*, which looks at the interplay between mathematics and the visual arts. She also gave talks at the Joint Mathematics meetings in Washington, D.C., and at the Southeastern Estuarine Research Society’s semiannual meeting at Coastal Carolina University in Conway, S.C.

After the time afforded to him by a Jepson Fellowship last year, **Randall Helmstutler** finished the first part of his book, titled *Topology Explained*. Dr. Helmstutler delivered

an invited colloquium talk at James Madison University last March, and recently his paper, co-authored with alumnus Roberto Palomba, was accepted for publication. He also ran a week-long workshop on problem-solving techniques for the Commonwealth Governor’s School in July.

In the spring, **Keith Mellinger** was the invited plenary speaker at the fifth annual East Coast Combinatorics Conference in Saint John, New Brunswick, Canada. Dr. Mellinger published papers on two-dimensional optical codes this year, as well as an expository paper on the famous Kirkman Schoolgirls Problem in *Mathematics Magazine*, one of the MAA’s widely distributed journals.

Janusz Konieczny continued his research in semigroups this past year, publishing two papers on the topic, including the article “Automorphisms of Endomorphism Monoids of 1-Simple Free Algebras,” which appeared in the journal *Communications in Algebra*. Dr. K is an active reviewer of mathematical research, submitting several reviews of current research every year to the *Mathematical Reviews* database, maintained by the American Mathematical Society.

Gallery



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