

# Mathematics at UMW Fall 2006

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

## Welcome Back!

*Dr. Hydorn, chair*

Upon your return to campus this fall you most likely noticed a lot of changes, a few of which took place here in Trinkle. We now have a new classroom, B52, which used to be the computer training lab for the Department of Information Technologies. Several of our professors are teaching classes in that room starting this fall. We also have a new cart of iBook laptops that we share with the Education Department, which our faculty will begin to use in their classes. Plus, we have a new fulltime faculty member, Carmen Lefever, who joins us as a lecturer. You can read more about Ms. Lefever in an article in this newsletter.

Some things haven't changed, however! We will continue our fall speaker series, which this year will highlight the undergraduate research and internship experiences of some of our current students. Some students are also planning on presenting their undergraduate research projects at the Shenandoah Undergraduate Mathematics and Statistics (SUMS) Conference, to be held on the campus of James Madison University on Saturday, October 28. I hope you will consider attending this conference to support your fellow students and to learn more about undergraduate research opportunities. We will also continue our popular "Pizza and Problem Solving" sessions. Dr. Mellinger and Dr. Helmstutler led several well-attended sessions last year and we hope to see even more faculty and student involvement this year. Look for announcements for these and other events from your professors and me.

From recent MAA publications and short courses for mathematics faculty I have learned of several "hot" areas for mathematics students to consider for potential career and/or graduate school studies. These include biomathematics, financial mathematics and computational mathematics. Let me know if you would be interested in a Special Topics course in one of these or other areas of mathematics. And, as always, if there is a topic that you are interested in that we don't offer as a regular course, you may be able to participate in an independent study, undergraduate research or honors project on that topic with one of our professors. Please talk with your professors about these and other department opportunities.

Best wishes for a successful year!  $\Omega$

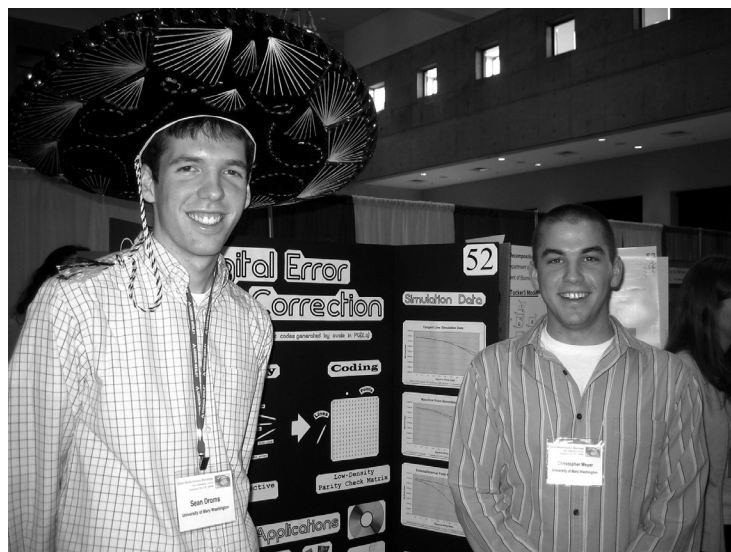
## Students Honored at National Meetings

A few of our majors received prizes at national meetings in 2006. First, students Sean Droms (07) and Chris Meyer (06) received \$100 for their poster at the national Joint Mathematics Meetings in San Antonio, TX, in January of 2006. Their work was based on a coding theory project completed during the 2005 UMW Summer Science Institute under the direction of Dr. Mellinger. More about



*Gardner Marshall*

their project can be found in last year's fall newsletter. In addition, senior Gardner Marshall won \$150 at the national MAA meeting in Knoxville, TN, for his presentation titled "An Investigation of the Spin Groups." Gardner's project was completed as part of the 2006 UMW Summer Science Institute under the direction of Dr. Helmstutler. Read more about his project on page 3.  $\Omega$



*Sean Droms & Chris Meyer*

## Welcome Carmen Lefever

The department is happy to welcome Ms. Carmen Lefever to our faculty. Ms. Lefever joins us as a lecturer and will be teaching many of our 100 and 200 level course offerings as well as coordinating some of the lower level courses with high enrollment. Originally from New Jersey, Ms. Lefever received a BA in mathematics from The College of New Jersey. For the past five years, she lived in Columbus, Ohio, spending four years in a mathematics graduate program at The Ohio State University where she received an MS in mathematics. Last year Ms. Lefever was a course coordinator for two of the lower level mathematics courses at OSU. She likes to watch baseball and is a fan of the New York Mets. In her spare time, Ms. Lefever enjoys playing recreational softball, listening to music, and attending concerts. She is very excited about teaching at UMW, and we are happy that she has decided to join us. Make her feel welcome when you see her around Trinkle!  $\Omega$



*Carmen Lefever*

## Student Opportunities

As you move into your junior or senior year as a mathematics major here at the University of Mary Washington, you might consider adding to your resume by exploring some of the wonderful opportunities that the department and mathematical community have to offer. Many seniors take advantage of the opportunities for undergraduate research, internships, honors projects, and independent studies. This is a truly terrific way to make your resume stand out in the crowd and make you more attractive to graduate schools and employers. One thing to stress is that these opportunities are not just for those students who want to pursue more mathematics in graduate school. A solid independent project with a faculty member is attractive, no matter what your future plans are. Here's a glimpse of what some of our majors have done.

- Dr. Konieczny supervised a directed study with Matthew Welz (03) on the theory of extension fields and its applications to geometric constructions. Matt wrote a 19-page honors thesis detailing his work. After graduating, he was accepted by Penn State to their Ph.D. program in mathematics, and is now studying at Colorado State.
- Mandy Passmore (05) completed an honors project in combinatorics under Dr. Mellinger during her senior year. In May 2007 she will graduate from Florida State University with

### Student Opportunities (continued)

a master's degree in financial mathematics with a concentration in actuarial science. She is taking some of the actuarial exams and plans to get a job as an actuary or try to become a certified financial advisor and work in the finance department of a business.

- In the first joint project between Mathematics and Biology, Lisa Song (05) completed an honors thesis under Dr. Edmunds. Her project used a stochastic population model to study the dynamics of a local plant species studied by Dr. Alan Griffith from the biology department. She was awarded honors in both mathematics and biology for her efforts. Lisa intends to enter a graduate program that will allow her to complete both a medical degree as well as a Ph.D. with an emphasis on mathematical modeling.
- Jenny Stovall (05) did work with Dr. Mellinger during the summer science institute in 2004. Her project in coding theory developed into an individual study and eventually an honors project the following academic year. Jenny is now working on her master's degree in mathematics at the University of Delaware and is spending the summer of 2006 working on a research project in mathematics education.
- After completing an honors thesis in number theory under the direction of Dr. Lehman, Dan Bowers (05) was accepted to graduate school at the University of Wyoming. He plans to graduate in May 2007 with a masters degree in applied mathematics and start work full time at Dahlgren.
- Under the advisement of Dr. Edmunds, Allison Piccolo (06) followed up research conducted in the summer of 2005 with an honors thesis where she used computer simulations to study the impact of initial stage distributions of two competing species on the final outcome. Allison graduated with honors in mathematics and is now enrolled in the UMW Masters program in elementary education.
- In 2006 Amanda Matthews (06), Brett Townsend (06), and Jennifer Warren (06) worked together on a project involving mathematical models of competition between two species of insects. Their work served as a preliminary investigation into what will eventually be actual laboratory experiments. Brett is now enrolled in a graduate program in applied mathematics at Montana State University, while Amanda and Jennifer have both landed positions at Dahlgren.
- Chris Meyer (06) completed an independent study and subsequent honors project in coding theory under the direction of Dr. Mellinger during his senior year. He now works at the Joint Warfare Analysis Center in Dahlgren using mathematics to analyze and solve problems for the Department of Defense.

**Senior Opportunities (continued)**

- During the spring semester of 2006, Bryan Beers (07) worked as an intern for Legg Mason, an investment firm in downtown Fredericksburg. He worked on individual portfolios analyzing how people were investing and if they were proportionately balanced for their needs. Bryan would review a client's investments, find the percentage of each investment compared to the overall portfolio, and make recommendations.
- During the summer of 2006, Kate Perrone (07) participated in the Summer Aerospace Workforce Development Research Internship Program (SAWDRIP) working for Honeywell Technology Solutions. Kate has always been interested in space missions and sees NASA as a potential employer one day.
- Bob Carrico (07) completed a research project under Dr. Hydorn during the 2006 Summer Science Institute. He plans on going into graduate studies in statistics or biostatistics, and would like to start a PhD program right after graduation. Eventually, he plans either to go into academia or to use a biostatistics degree in the private sector with a pharmaceutical company or other medical research institution.
- After having completed a research project on spin groups during the Summer Science Institute of 2006, Gardner Marshall (07) plans to study matrix representations of the spin groups using Clifford algebras during his last year at UMW and aspires to attend graduate school to study theoretical physics.
- Juliette Zerick (08) participated in the NASA Student Internship Program during the summer of 2006. She spent ten weeks at Goddard Space Flight Center in Greenbelt, Maryland paired with a mentor who was working on the National Polar-Orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP).

Also, take note of the other articles in this newsletter about the Summer Science Institute, and summer research programs funded by the National Science Foundation. For more information about these and other opportunities, ask your professors or check out the Student Opportunities link on the department's website. [Ω](#)

## Summer Research at UMW

For the third year in a row, the mathematics department at UMW participated in the Summer Science Institute with two faculty and four students. This year, the projects were about as different as topology and statistics. Ok, those were the actual topics.

First are seniors Gardner Marshall and Ryan Platt who worked with Dr. Helmstutler on research in topology. Both projects utilized methods of homotopy theory and abstract algebra to examine certain

**Summer Research (continued)**

*Gardner Marshall, Dr. Helmstutler & Ryan Platt*

geometric problems in higher dimensions. Ryan worked on extending a theorem on spheres (the Borsuk-Ulam Theorem) to higher dimensions, and then used the results to solve some classical partitioning problems on spheres. Gardner gave an in-depth analysis of some exotic topological objects known as the “spin groups” and learned how they model strange rotational phenomena in quantum physics. Gardner accompanied Dr. Helmstutler to the national MAA meeting in Knoxville, TN, where he won a top prize for his talk titled “An Investigation of the Spin Groups.” If you want to hear more about their projects, just ask the students or Dr. Helmstutler. The students created visual aids to help explain parts of their projects, and these are on display in Dr. Helmstutler's office. Stop by if you want to see them!

Erin Keegan and Bob Carrico worked with Dr. Hydorn on two research projects in probability and statistics. For the first project Erin and Bob derived the distribution of the number of shared items in the top  $n$  of three randomly ordered lists of  $N$  numbers. This distribution is useful for analyzing and interpreting the results of surveys administered to three different groups. Erin and Bob also derived the expected value and variance of the distribution, and made some conjectures as to the form of the distribution for the problem extended to more than three lists. For the second project, Erin and Bob had to learn some multivariate statistics to apply toward the problem of estimating the eigenvalues of a covariance matrix for bivariate normal data. Eigenvalues play an important role in principal components analysis and factor analysis, two methods for variable reduction in large data sets. For both projects Erin and Bob learned how to program in Mathematica so that they could run a large number of computer simulations to study the properties of the results they had derived. [Ω](#)



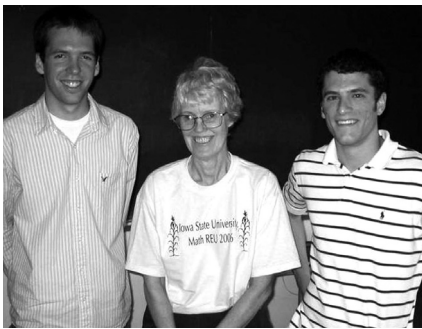
*Bob Carrico, Dr. Hydorn & Erin Keegan*



## Experiencing an NSF Funded REU


*Sean Droms*

In June and July, I participated in the Research Experience for Undergraduates (REU) at Iowa State University. The REU program is sponsored by the National Science Foundation and sends a few students to schools around the country to experience math and science research firsthand, and pays a significant stipend. At Iowa State, a student from Harvey-Mudd College and I worked with a professor on a project combining areas of graph theory and linear algebra, which has resulted in a paper we are submitting to a research-level mathematics journal. He and I studied generalized adjacency matrices for particular graphs, and by modifying the entries in the matrices, determined the “minimum rank” of a class of graphs. We expanded earlier results to arbitrary fields other than the real numbers, and came up with some theorems of our own involving the minimum ranks of paths, cycles, graph sums, and linear 2-trees. I learned many new areas of mathematics while experiencing what real math research is like, which is a must if you’re thinking of entering graduate school.



*Sean Droms with his research team in Iowa*


The program lasted eight weeks, with food, housing, and some travel money all provided. My partner and I even got our own office. An REU is an excellent replacement for a summer job, and is a very attractive addition to a graduate school or job application. I made twelve great new friends

from all over the country, and made valuable connections with the ISU faculty. REU programs are available at dozens of large and small colleges, in most states, and in many different areas of mathematics. A list can be found on the NSF website. Applications are generally due in February or March. The program was fantastic, and gave me a chance to work on mathematics that hasn’t been done before, outside of the textbook problems and classes. It’s a great opportunity to learn what real math is about, and I strongly encourage anyone who is interested to apply, especially if you’re planning to go on to grad school. If you have any questions about the application process or the program itself, please contact me through email at [sdrom1uj@umw.edu](mailto:sdrom1uj@umw.edu). 

## A week of research in Sarasota, FL

*Ryan Johnson*

During the month of June, I was invited to a week-long workshop at New College of Florida. This workshop brought 12 students together from all across the nation and four professors from several distinguished universities. The workshop was funded by the National Science Foundation. While I was there we were introduced to a broad range of new topics, and applications of more familiar topics. We were encouraged to investigate these topics and to find patterns and attempt proofs of these. Each day we were given ample time to research the topics and were given the opportunity to investigate problems that we found during our research. I worked with a professor from Salisbury University on Cellular Automata which involves Number Theory and Linear Algebra. At the end of the week, we were given the opportunity to present what we had found during the week. I am in the process of completing my paper on the findings I discovered on fixed points in Cellular Automata.

In addition to the incredible experience of participating in mathematics research, I was also able to enjoy the amazing sights in Sarasota. All of the students that attended the workshop were given rooms at the campus and we often dined at the campus hall or were treated to meals out in town. On top of these great benefits, all of our travel expenses were paid for and we were given a sizable stipend for our time there. The workshop certainly challenged us to think as mathematicians and gave us a glimpse into the ever-changing world of mathematics. 



*Ryan Johnson with his research group in Florida*

## Upcoming Electives

For planning purposes, here is a list of some of the upcoming electives and otherwise-not-regularly-offered courses that the department expects to be offering.

**Spring 07:** 330 — Foundations of Advanced Mathematics; 411 — Chaotic Dynamical Systems; 372 — Non-Euclidean Geometry; and 442 — Topology II

**Fall 07:** 321 — Number Theory; 381 — Probability and Statistical Inference I; 412 — Complex Variables

**Spring 08:** 330 — Foundations of Advanced Mathematics; 351 — Numerical Analysis; 372 — Non-Euclidean Geometry

## New MAA Officers

Our student section of the Mathematical Association of America elected new officers this past spring, including Stephen Grodek, Susan Alexander, and Michelle Welcher. MAA [www.MAA.ORG](http://www.MAA.ORG) sponsors many activities throughout the year and the new officers are geared up and ready for an eventful and exciting year. Keep your eye out for information about the first meeting.  $\Omega$



## New Master of Education for Secondary School Teachers



Marie Sheckels

The Mathematics Department is pleased to announce the first cohort of its new MAED program for Fall 2006. Offered under the Masters of Education Program at UMW's College of Graduate and Professional Studies, the MAED courses are geared toward current high school mathematics teachers with an undergraduate degree in mathematics or with a strong mathematics background. The program is being offered to meet a demand from local high school teachers for a masters degree program, and consists of 10 "mathematics for teachers" courses, of which program participants must complete 9, and 3 required CGPS Track II courses. According to the Academic Council Proposal submitted to CGPS, the courses are designed to strengthen the content and pedagogical knowledge of working teachers. The program will help teachers to be more effective in the classroom, and to become better prepared to teach Advance Placement and International Baccalaureate courses, as well as the "dual enrollment" courses offered at high schools in cooperation with community colleges.

### MAED (continued)

Offered this fall, MAED 510 Linear Algebra for Teachers is the first course to be offered under this program and will be taught by Dr. Helmstutler. MAED 520 Discrete Mathematics for Teachers will follow in the spring, taught by Dr. Mellinger. Development funds for MAED 520, and for MAED 530 Probability and Statistics for Teachers to be offered later next year, were made possible through a 2005-06 Mathematics and Science Partnership Grant received by Dr. Marie Sheckels, in conjunction with faculty from James Madison University. Under this grant, JMU faculty are developing two additional courses for their new masters of mathematics education program, to be offered to teachers in the Richmond area; funding for all four courses provides resources for faculty to develop courses using best practices for adult learners, including integrated online teaching components. According to the Academic Council Proposal, "Education faculty from each college will work with the mathematics faculty from the College of Arts and Sciences to develop and teach the courses in this program. This would be the first degree offering of its kind at the University."  $\Omega$

## Dr. Mellinger receives research grant from the National Security Agency

In February 2006, Keith Mellinger was awarded a \$25,576 Young Investigator Grant from the National Security Agency for his proposal titled "Theory and Application of Incidence Structures Arising from Finite Geometries." The grant provides him with travel money and additional summer salary for two years. In return, Dr. Mellinger will be spending his summers working on solutions to problems in discrete mathematics. In his proposal, he outlines various unsolved problems in finite geometry, extremal graph theory, and the theory of error-correcting codes, as well as various ideas on how to attack them.



Keith E. Mellinger

The NSA awards mathematical research grants on four factors that demonstrate the scientific merit of the proposal, including the prospect that the research will lead to important discoveries; the prospect that it will produce innovations or significant improvements in investigative methods, including methods of computation; the investigator's scientific qualifications and accomplishments; and the investigator's demonstrated awareness of previous approaches to the problem. It is awarded to promising investigators within ten years of receiving their doctorate.  $\Omega$



## Professional Activity... and other interesting tidbits

In August, Yuan-Jen Chiang presented a joint paper “Transversally biharmonic maps between foliated Riemannian manifolds” (with Robert Wolak) at the International Congress of Mathematicians in Madrid, Spain. The International Congress is the largest mathematics conference in the world and winners of the Fields Medal (the highest honor in mathematics) are announced there. Jeff Edmunds gave a presentation titled “Modeling Competition Between Inhibitory and Purely Cannibalistic Species of Flour Beetles” at the annual meeting of the Society for Industrial and Applied Mathematics (SIAM) in Boston in July. In August, he presented a poster titled “The Effect of Stage Distribution on Basins of Attraction” at the annual meeting of the Society for Mathematical Biology in Raleigh. The poster was based on work done with recent graduate Allison Piccolo. Randall Helmstutler gave several talks this past year, including colloquium talks at Longwood University and Randolph-Macon College. In August he gave a presentation on the interaction between topology and linear algebra at the national MAA meeting in Knoxville, TN, and he participated in Project NExT workshops in Albuquerque, San Antonio and Knoxville. He reports that carpentry has never before played a role in his research. Stop by his office to see the results. Debra Hydorn wrote an SPSS technology manual to accompany a new introductory statistics text that was published by Pearson/Prentice Hall in January 2006. She also produced SPSS output for the textbook authors to include within the text.

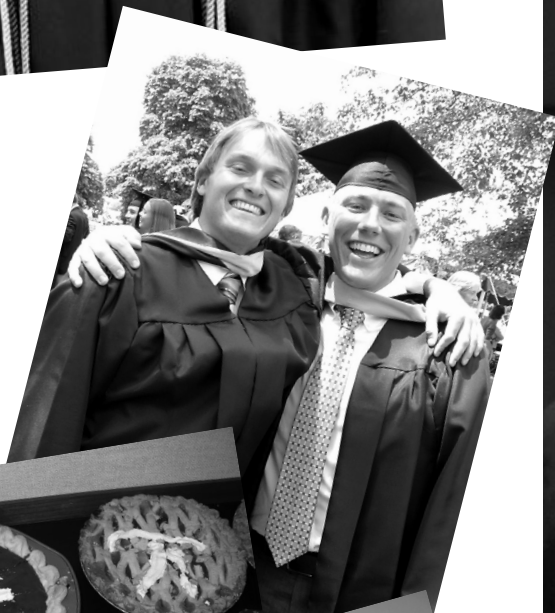
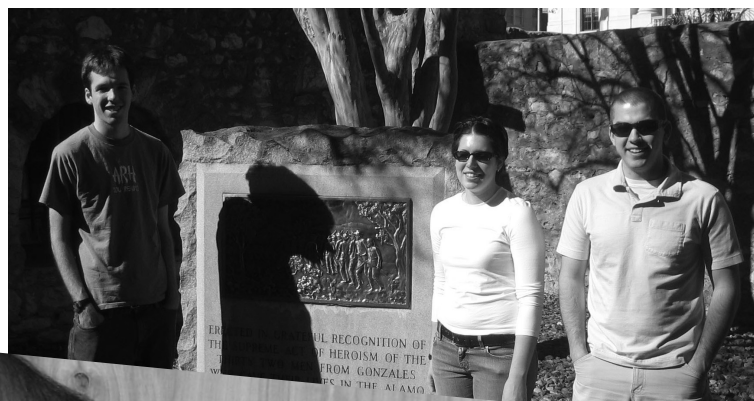
The article “Balanced subgroups of symmetric groups” co-written by Larry Lehman, Janusz Konieczny, and professor emeritus Stephen Lipscomb was published this past year in the JP Journal of Algebra, Number Theory, and Applications. Dr. Lehman also reports surviving a 50-mile round trip bike ride to Lake Anna this summer with Bob Carrico, mathematics major and member of the UMW cycling team. Last November, Keith Mellinger spent two days at Virginia Tech giving a series of talks to the undergraduate mathematics club, the graduate students, and the department faculty. His graduate student talk titled “Starting a Career in Academia” was converted to a short article that appeared in the fall issue of FOCUS. Dr. Mellinger is currently playing guitar and mandolin for the Fall Line Bluegrass Band who released their first album last June. Wyatt Mangum and Suzanne Sumner were invited to present their research at the International Union for the Study of Social Insects conference in Washington, DC, August 2006. Their lecture described the chaotic aggression patterns observed among worker bees when introducing a foreign honey bee queen into a colony. Dr. Sumner survived climbing Old Rag Mountain with Dan Fovargue, mathematics and computer science

### Professional Activity (continued)

major, and his UMW pals David Riley and Matt Tucker, who were the winning bidders at the Topher Bill Auction. On a final note, Dr. Helmstutler reports that there was but one serious contender in Randall's 2006 Music Challenge. Better luck next year folks.

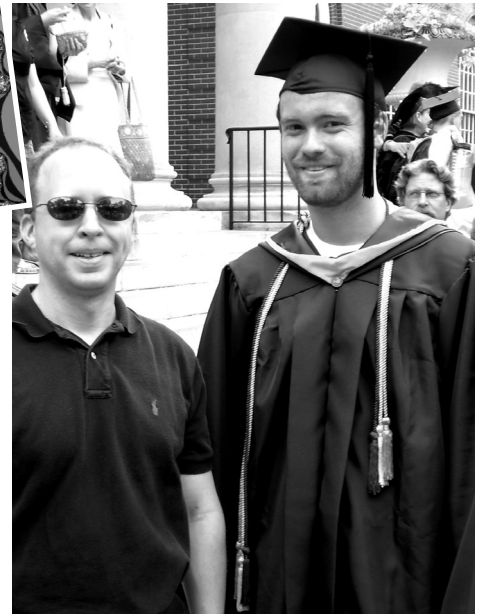
## Gallery







Gallery (continued)



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