Mathematics at UMW

Fall 2007

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

Welcome Back!

Dr. Hydorn, chair

I hope you're ready for another great year! Plans for our **Fall Speaker Series** are well under way, including presentations by the students who participated in UMW's **Summer Science Institute**. In addition to a talk to be given by Dr. Konieczny in November we are also hoping to bring in speakers from VCU and the University of Delaware. In weeks when we don't have a talk scheduled we'll plan on holding **Pizza and Problems** sessions or some other activity. And, we'll be continuing our tradition of **Pumpkin Pi Day** during the week before Thanksgiving. In the spring, we'll have **Pi Day**, of course, and also plan on holding **Mathematics Awareness Talks** in March.

The department has several new offerings this year, including a **First Year Seminar** on problem solving, to be taught by Dr. Helmstutler in the fall and Dr. Mellinger in the spring. This course joins the seminar on chaos first taught by Dr. Edmunds last year, to be taught again this year by Dr. Edmunds in the fall and Dr. Sumner in the spring. We are also offering two research opportunities as part of the university's new **URES 197** series, one to be held by Dr. Edmunds (on population dynamics) and the other by me (on statistical consulting).

In addition to the faculty activities mentioned in this newsletter, please check out the section on what our students have been doing. The number of our mathematics majors participating in undergraduate research and internships is growing each year and we are very proud of their accomplishments.

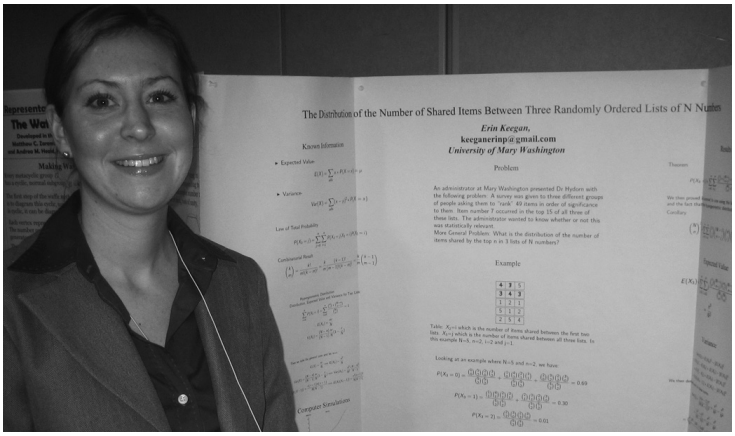
Finally, the department will be conducting a search this year to bring in a new faculty member in Applied Mathematics. We hope to be conducting interviews in January so please watch for announcements about meeting the candidates and attending their presentations.

Many thanks again to Dr. Mellinger for coordinating the Newsletter this year. Please let him know if you have ideas for articles in future editions!

Best wishes for a successful year! Ω

Students attend national meeting in New Orleans

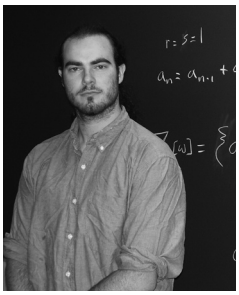
Three of our recent graduates, Sean Droms, Bob Carrico and Erin Keegan, were in attendance at the Joint Mathematics Meetings in New Orleans last January. All three entered posters in the national undergraduate student poster competition, with Sean receiving one of the top prizes. His project was based on work completed as part of an NSF funded REU (Research Experiences for Undergraduates) at the University of Iowa during the summer of 2006. Bob and Erin's projects were completed as part of the Jepson Summer Science program here at UMW the same summer. Ω



UNIVERSITY OF MARY WASHINGTON

Summer Research at UMW

The mathematics department at UMW participated in the Summer Science Institute with two students. Projects this year focused on number theory and topology. First was Christopher Triola who worked with Dr. Lehman on research related to recursive sequences of integers, taken modulo primes. They generalized results about the periodicity of second-order linear homogeneous recurrence relations, such as the Fibonacci sequence, to higher orders, using methods from number theory and abstract algebra. The main new result was a criterion for the factorization of cubic polynomials modulo prime numbers in terms of the period lengths of related third-order recurrence relations.



Christopher Triola

The second project had Roberto Palomba studying category theory with Dr. Helmstutler. Roberto's project was an attempt to understand certain kinds of categories arising in algebraic topology by using structural results from semigroup theory. Together they were able to show that such categories must exhibit a very strong homogeneity property, and this in turn gives a convenient partial classification of these categories. Roberto presented the findings at the August national meeting of the MAA in San Jose, CA. Ω

Roberto Palomba

New Mathematics Major Requirements

Upon examination of our major requirements in the last few years, the department has unanimously agreed on a new set of requirements in order to provide more flexibility for our students. Starting fall of 2007, a total of 36 credits is required for the major. Fifteen of those credits are earned by taking the core courses: Calculus III, Multivariable Calculus, Linear Algebra, Abstract Algebra I, and Real Analysis I. An additional 3 credits must be earned from completion of one of the 400-level sequences by taking Abstract Algebra II, Topology II, or Real Analysis II. There are 18 more credits required for the major and there is quite a bit of flexibility on how to complete these remaining credits. Students are no longer required to take Discrete Mathematics or Topology, and there is more flexibility in how to complete the required 400-level course work. For a complete description of the major, check out the department's website or pick up a new edition of the Handbook for Mathematics Majors which is available in the department. Ω

2007 Honors in Mathematics

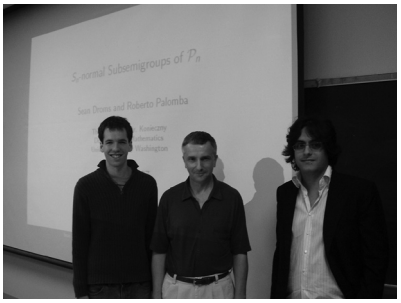
The past academic year was another blockbuster year for honors projects. The department has offered students the opportunity to graduate with the honors distinction for many years. Recently, more and more students are taking advantage of the opportunity to earn this honorable distinction. Here are the highlights from last year.

First was student Gardner Marshall who completed a project in Lie theory (a blend of abstract algebra and topology) under Dr. Helmstutler. Gardner's honors thesis was titled *A Lie-Theoretic Approach to the Spin Groups* and constituted an effort to understand the spin groups by invoking known results from the theory of Lie algebras. The approach taken implemented some techniques from a branch of mathematics known as representation theory. This gave rise to matrix representations of the low-dimensional spin groups (i.e., lots and lots of abstract and linear algebra). Gardner begins a Ph.D. program in theoretical physics at the College of William and Mary this fall.

Ryan Johnson completed an honors project in graph theory titled *An Investigation of a Min-Max Scheduling Problem*. Working with Dr. Mellinger, Ryan's project involved an attempt to partition students into groups over several days, but subject to the condition that no pair of students works together more than once. The goal was to determine the minimum length of a maximal schedule, that is, a schedule that cannot be extended due to the condition. He was able to determine this minimum number when the students are partitioned into pairs. Ryan accepted a fellowship position at the University of Delaware and begins their graduate mathematics program this fall.

Next up was Bob Carrico who did a project in Statistics under the advisement of Dr. Hydorn. His project was titled *Estimating the Eigenvalues of Covariance Matrices using Confidence Intervals*. In statistics, the covariance matrix provides information about how much a variable varies within itself and with other variables. In Bob's project, interval estimates of the population eigenvalues

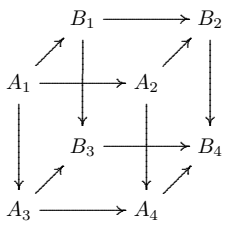
were constructed, using confidence interval estimates of the population characteristic polynomial. Expressions for the variance of the polynomial were found and then simulations were run using a variety of different sets of eigenvalues and samples sizes, to determine the proportion of times that the interval estimates contain the true values of the eigenvalues. Bob starts a Ph.D. program in Biostatistics at Virginia Commonwealth University this fall.



Finally, Sean Droms completed the project *Partial Linear Transformations of a Vector Space* in the area of abstract algebra under the direction of Dr. Konieczny. Sean investigated the semigroup *PL(V)* of linear transformations whose domain and image are subspaces of an arbitrary vector space *V*, where the operation is the function composition. He determined both the global and local structure of this semigroup as well as the structure of the subsemigroup of *PL(V)* consisting of one-to-one transformations. He also obtained some counting formulas. This fall, Sean starts the graduate program in mathematics at the University of Virginia. Ω

Learn to use LaTeX

Back by popular demand, Dr. Helmstutler will be offering a LaTeX workshop in the fall semester. LaTeX is the industry standard in mathematics for typesetting and preparing documents. The



effective use of the LaTeX system makes your mathematics read better, leads to a much more manageable writing process, and is a valuable employable skill. You can learn the essentials in only two meetings, and after this most people are able to teach themselves the other tricks of the trade. We will offer four sessions covering the essentials of getting started, techniques for managing larger documents (like an honors thesis), and methods of using LaTeX to give presentations (like PowerPoint formats, but for mathematics). Look for the sign-up sheet early in the fall semester, and ask Dr. Helmstutler if you have questions. Ω

Department holds Calculus Tournament for area high schools

In April the MAA student group sponsored the first annual UMW Calculus tournament for local high school students preparing for the AP exam. Eight teams from four local high schools (Mountain View, Spotsylvania, Orange County, and Paul VI in Fairfax) competed in a Jeopardy-style, single-elimination competition. In a highly competitive and tense final round, the Unknown team from Orange County High pulled out the championship on a difficult final question, narrowly defeating one of the Mountain View teams. A good time was had by all, and the department plans to continue the tradition in future years. Ω

Upcoming Electives

For planning purposes, here is a list of some of the upcoming electives and *otherwise-not-regularly-offered* courses that the department plans to be offering in the coming semesters. Keep your eye on the registrar's website for the most up-to-date information.

Spring 08: Math 330 – Foundations of Advanced Mathematics, Math 411 – Chaotic Dynamical Systems

Fall 08: Math 321 – Number Theory, Math 351 – Numerical Analysis, and Math 372 – Non-Euclidean Geometry

Spring 09: Math 330 – Foundations of Advanced Mathematics, Math 381 – Probability and Statistical Inference, and Math 412 – Complex Variables Ω

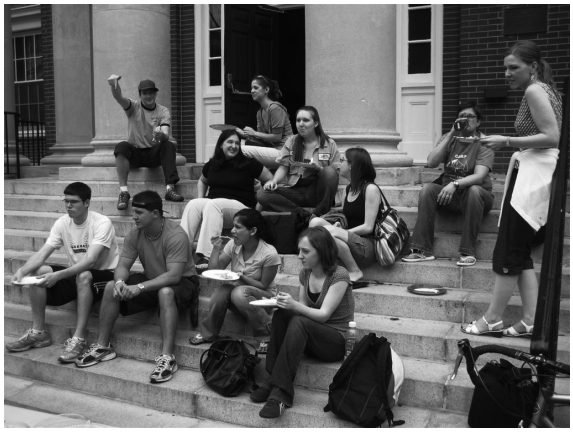
Professional Activity… and other interesting tidbits

Your professors continue to remain active outside of the classroom. From honors project supervision, to general education reform, to mathematical research, these are exciting and productive times for the department. Many of our faculty delivered professional presentations at conferences and universities this year. **Jeff Edmunds** gave a presentation titled *A Discrete Competition Model with Periodically Oscillating Habitat Size* at the International Conference on Difference Equations and Applications in Lisbon, Portugal, in July. **Debra Hydorn** gave a presentation on *Mentoring Undergraduate Research in Statistics* at the Joint Statistics Meeting in Salt Lake City in August. Her talk described the projects completed with UMW students Bob Carrico and Erin Keegan during the summer of 2006. Dr. Hydorn also had an article published in the *Journal of Statistics Education*. Last March, **Yuan-Jen Chiang** was invited to the University of Kentucky to speak about some of her work on transversally biharmonic maps. Lastly, **Wyatt Mangum** and **Suzanne Sumner** presented their mathematical modeling research with honey bees at the Apimondia International Apicultural Congress in Melbourne, Australia. Dr. Mangum's presentation was titled *A Four-Year Varroa Mite Population Dynamics Study Including Fluvalinate-Resistant Mites* and Dr. Sumner's talk was about *Aggression Towards A Foreign Queen: Deterministic And Stochastic Modeling With Empirical Data*. Dr. Sumner was asked to do a reading at her neighbor's wedding on the lucky date 7/7/07. To her surprise, the pastor was a former student, from her first year at the College! Ω

Janusz Konieczny published two research articles this past year and remained quite busy supervising two honors theses in semigroup theory. At the national meeting of the MAA held in San Jose, CA, in August, **Randall Helmstutler** served as a judge for some of the undergraduate student presentations. **Keith Mellinger** spent a week as a visiting scholar at the University of New Brunswick – Saint John, Canada, in July. He spent about 80% of his time working on optical codes, and the remainder of his time eating shellfish. Last spring we welcomed Dr. Mellinger's daughter Cecilia Dawne who was born in March. And finally, **Gary Collier** spent last spring in isolation in Richmond. He was taking a much needed sabbatical working on a 200-page book on metric spaces. Stay tuned Math 471 students. You'll be seeing the book soon enough. Ω

Gallery

Graduation



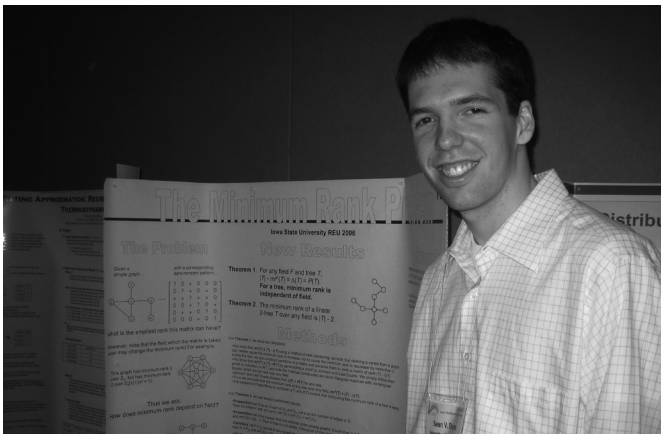
Pi Day

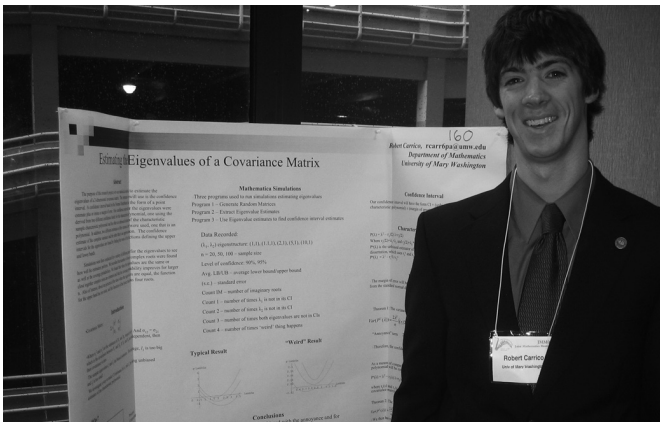
Math Awareness Month

Spring Picnic

Gallery continued

New Orleans





UNIVERSITY OF MARY WASHINGTON

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

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