

Duke University

Math News

October 9, 2008



• ◆ • FALL 2008 EDITION • ◆ •

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Welcome

As Director of Undergraduate Studies in the Mathematics Department, I am happy to welcome you back for the new academic year and to mention a few resources available to you. Clark Bray, the Associate Director of Undergraduate Studies, is working closely with me to assist you.

You can find lots of information at our web site. From www.math.duke.edu, click on News of Department for past issues of the Duke Math News as well as information about those in our community. Click on the **undergraduate program** or **undergraduate mathematics** to get to various pages about courses, transfer credit, study abroad and others items of interest to majors. The on-line version of our Handbook for Majors and Minors has detailed lists of courses and requirements, suggested courses for various career directions, etc. (If you did not receive a paper copy, you can pick one up in the Department Office.) From the **undergraduate** web page or the top page, you can get to DUMU (the Duke University Math Union) for information about social activities, the Duke Math Meet in November, and other events. There are also a few external links to math societies etc. The page **Why major in math?** has some comments about career paths (scroll down).

I am available to you for advice and questions. You are welcome to contact me by email or to meet with me. My office is 217 in the Physics Bldg. You can try to catch me when I am free, or you can send an email suggesting some times you would like to meet, and we will schedule a meeting.

—Thomas Beale, DUS

Undergraduate News

DUMU

The Math Club, the Duke University Math Union, sponsored its first social event on Saturday, September 20. Nearly 50 students came to partake of Thai food while they enjoyed conversation and Frisbee. Thanks to Social Chair, Top Chongchitmate, for organizing this fun event. In addition to various math contests (see below), DUMU will host other social events and will challenge the Society of Physics Students to a basketball game. As in the past, DUMU plans to invite a distinguished speaker to give a talk at the undergraduate level. We welcome your participation and suggestions for other activities. For more information, contact DUMU secretary Yiwen Zhu (yz73).

Competitions

All undergraduates are eligible to participate in various mathematical competitions. The Virginia Tech Math Contest will take place from 9 to 11:30 on Saturday, November 1, 2008. The more challenging W. L. Putnam Mathematical Competition will be held on Saturday, December 6, 2008, the day after classes end. These competitions require creative insight and rigorous proofs more than technical knowledge of higher math. A Problem Solving Seminar is held in Math Physics 119 each Monday evening from 8 to 10. All interested students are invited to attend these practice sessions. Contact Aaron Pollack (ajp13) or Jason Ferguson (jmf22) for more information.

The Mathematics Contest in Modeling and the Interdisciplinary Contest in Modeling occupies a four day weekend in early February. Teams of three students are given open-ended, real-life problems and are expected to produce a major research paper at the end of the 96 hour contest. Since 1998, 14 Duke

teams have been named Outstanding and their papers have been published in the UMAP journal.

For more information about these contests, contact contest coordinator David Kraines (dkrain@math.duke.edu) and see www.math.duke.edu/news/awards/competitions.html.

High School Math Meet

Preparations are underway for the annual Duke Math Meet to be held on Saturday, November 15, 2008. Duke students create and grade problems for this ARML style meet and present awards to the winning teams and individuals. Last year, nearly 200 high school students from Alabama to Northern Virginia participated in this event. Volunteers are needed to help with registration, to distribute box lunches and other activities. Encourage your former high school math teacher to send a team. Contact Matt Rognlie (mjr16) for more information.

Summer research opportunities

The PRUV Fellow program provides summer stipends for math majors to engage in a mathematical research project leading to a senior thesis and Graduation with Distinction honors. Each summer since 2000, five to eight undergraduates have been paired with faculty mentors and given stipends for six weeks of intensive research. The 2008 PRUV Fellows, Brian Choi, Wutichai Chongchitmate, Yajing Gao, Mark Hallen, Aaron Pollack and Amy Wen, each presented short talks on their research recently. For more information and an application, see www.math.duke.edu/vigre/pruv/ or contact David Kraines dkrain@math.duke.edu.

Even in these tight economic times, internships and research opportunities are available throughout the country for math and math related activities. Over the past decades, Duke students have attended many of the NSF sponsored Research Experience for Undergraduates programs in math. A list of such programs for summer of 2009 should be available by the end of this year.

Faculty Scholar

Congratulations to senior Aaron Pollack, recently named as one of three Duke Faculty Scholars. Aaron is an A.B. Duke Scholar, a PRUV Fellow, a winner of the Math Contest in Modeling, and was awarded Honorable Mention on the Putnam Competition. Among his other activities, Aaron is co-instructor of the Problem Solving Seminar and president of DUMU. He has excelled in eight graduate mathematics courses and five graduate physics courses to date. In his senior thesis, being written under the mentorship of Professor Richard Hain, Aaron relates modular forms to relations between certain special derivations of a free Lie algebra related to elliptic curves.

Graduate Program News

We are happy to welcome the new graduate students:

- **Miles Crosskey** from Rensselaer Polytechnic Institute
- **Elizabeth (Liz) Munch** from the University of Rochester
- **Harrison Potter** from Marietta College
- **John Steenbergen** from Purdue University
- **Albert Steppi** from the University of Central Florida
- **Yi Li** from Duke University Graduate School (chemistry)

—Harold Layton

Rann Bar-on Receives Teaching Award

At the departmental meeting in September, Rann Bar-on was presented the 2007-2008 L.P. and Barbara Smith Award for Excellence in Teaching. Rann has been praised by his students for his excellent teaching and his enthusiasm in helping them to succeed. He has been an active contributor to curriculum development in the Department, and in particular was one of the principal developers of the new Math 41L.

This award was funded by a generous donation from Capt. L.P. Smith and his wife Barbara Smith. L.P. was the Supervisor of First-year Instruction for many years, and at the time of his retirement, he and Barbara decided to provide a means for the department to recognize those graduate student who excel in teaching.

Rann has consistently been one of those dedicated and successful graduate student teachers whom L.P. and Barbara wanted to be recognized for their achievements. We congratulate Rann, and as we remain thankful for what L.P. did for this department, we also fondly remember the friendship and spirit of L.P. and Barbara.

—Lewis Blake

Special Topics Graduate Courses for Spring 2009

MATH 268.01: Topics in Differential Geometry (Tools in Gauge Theory)

Beginning about 30 years ago a remarkably fruitful interaction between physicists and mathematicians developed. Ideas from physics had profound implications in geometry (algebraic and differential) and topology, and vice-versa. At this intersection lies gauge theory, which for mathematicians is roughly the study of vector bundles and connections.

This course will cover some of the basic ideas and tools of gauge theory. Our aim will be to understand part of the methods used to prove exciting results about geometry and topology of low-dimensional manifold: possible intersection forms of 4-manifolds

(Donaldson), genus of embedded surfaces in projective plane (Kronheimer–Mrowka), obstructions to existence of Einstein metrics (LeBrun). If time permits, we will be able to understand the million dollar Clay Institute Millennium Problem on the mass gap.

Topics will include: vector bundles, connections, curvature and characteristic classes; the space of connections and gauge equivalences; the Yang–Mills equation, the ASD equation, the Seiberg–Witten equations, and relevant moduli spaces; convergence and compactness; existence and non-existence; invariants; dependence of the moduli space on the metric; etc.

—Instructor: Benoit Charbonneau

MATH 358.01: Combinatorial commutative algebra

This course will cover a selection of topics from the textbook *Combinatorial commutative algebra*, by Miller and Sturmfels. It will provide ring-theoretic viewpoints on combinatorial objects like simplicial complexes (via Stanley–Reisner rings and monomial ideals) and polyhedral cones (via semi-group rings), but also combinatorial viewpoints on algebraic objects like graded polynomial rings and local cohomology. Students looking to specialize in areas at the intersection of high-energy physics and algebraic geometry will find the material useful, since the algebra to be covered can be interpreted geometrically or topologically, in terms of torus actions, sheaf cohomology, or equivariant cohomology and K-theory.

Prerequisites: basic graduate algebra, including rings, fields, and abstract commutative algebra, as well as facility with algebraic topology, including simplicial complexes, chain complexes, and homology. Knowledge of polyhedra and their partially ordered sets of faces is recommended (at the level of Lectures 1 and 2 in Ziegler’s book, *Lectures on polytopes*, for example) but not strictly required. The course is intended for second-year graduate students and beyond, but it would be appropriate for first-years or undergraduates with extraordinary preparation in commutative algebra or algebraic topology.

—Instructor: Ezra Miller

Mini Courses

Schedule for minicourses this spring (subject to change). Course descriptions will be circulated later this fall.

- **Math 378** Chad Schoen, MWF, Jan 7 - Feb 9
Paul Aspinwall, MWF, Feb 11 - Mar 20
- **Math 388** Mike Reed, F, Jan 2 - Apr 17
Dave Schaeffer, TuTh, Mar 24 - Apr 21

Faculty News

New Faculty

The following professors and research associates have joined the department this fall:

- **Elizabeth Bouzarth**, Assistant Research Professor (Ph.D. from UNC). She works on computational fluid dynamics.
- **Daniel Rutherford**, Assistant Research Professor - (Ph.D. from University of California, Davis) He works on symplectic geometry and knot theory.
- **Amal El Moghraby**, Research Associate - (Ph.D. from Brown University). She works on dynamical systems and renal modeling.

Additional New Faculty

Joining our faculty beginning January 2009 will be:

- **Ezra Miller**, Professor (Ph.D. from University of California, Berkeley), comes to us from the University of Minnesota. He works on combinatorial aspects of geometry and algebra.
- **James Nolen**, Assistant Professor (Ph.D. from Stanford University). He works on probability and partial differential equations.

Mathematics at Duke; The Early History

One time Duke history professor, Robert F. Durden, has written extensively about the Duke family and the transformation of Trinity College into what has become one of the premier universities in the world. In his comprehensive *The Launching of Duke University, 1924-1949*, Duke University Press 1993, Durden outlines the early history of our math department. The following summary is based on Durden's description together with some information from the university archivist and contemporary web sites.

In 1891, shortly before Trinity College moved from Randolph County to Durham, Robert L. Flowers, a graduate of the US Naval Academy, was hired as a mathematics instructor. Flowers remained a very popular teacher and the chair of the department even after 1910 when he assumed the first of this many administrative roles. As vice president in 1924, Flowers played a significant role in persuading James Buchanan Duke to establish Duke University. He served as president of Duke University from 1941-1948.

Although Flowers and two other instructors remained in the department of the new Duke University, in keeping with plans to build a major university, the administration began to assemble a distinguished research mathematics faculty. In 1925, William W. Elliott became the first Ph.D. (Cornell) to teach mathematics at Duke, continuing for 43 years. Before his death at age 95 in 1993, Elliott had endowed a fund for postdoctoral positions that have since expanded into the Assistant Research Professorships and the Teaching Assistant Professorships.

Soon after inaugurating its new graduate school, the Duke math department awarded its first M.A. degree to John M. Clarkson in 1926. A few years after receiving his Ph.D. in Algebraic Geometry from Cornell, Clarkson joined the faculty of North Carolina State University in 1934 as one of the first two faculty members in mathematics with a doctorate.

In 1929, Canadian-born mathematician Arthur Hickson (Chicago 1928) joined the department and continued until his retirement in 1965. Julia Dale (Cornell 1924) joined him as the first woman professor in the department in 1930. She became ill a few years later and died in 1936. The Julia Dale prize became a lasting memorial to her. See

www.math.duke.edu/news/awards/dale/index.html
for more about her life and work.

Joseph M. Thomas (U Penn 1923) was recruited to Duke in 1930 and encouraged to establish the Duke Mathematical Journal with himself as editor. In his first year at Duke, Thomas supervised Duke's first Ph.D. student in mathematics, Ruth W. Stokes. Her thesis, *A Geometric Theory of Linear Inequalities*, and other aspects of her life and career have been described recently by the Southeastern Section of the MAA in <http://frodo.elon.edu/maase/s08newsletter.pdf>.

The reputation of the department was greatly enhanced with the arrival of John Roberts (Texas) and Leonard Carlitz (U Penn) in 1931 and 1932 respectively. The second Ph.D. in mathematics was awarded to Francis Dressel in 1933 who continued as a member of the faculty until he retired at age 70.

Our first chapter of this capsule history ends with the hiring of John J. Gergen (Rice) in 1936. Gergen, an established mathematician at the time, became chairman of the department year later and "tenaciously held that position" until shortly before his death in 1967. The Gergen lectures were established in his memory. See <http://www.math.duke.edu/info/gergen.html>.

(To be continued.)

Duke Math News

The *Duke Math News* is published several times a year and is distributed to those in the Duke mathematics community. For previous editions and other news, see www.math.duke.edu/news/. We welcome items of interest for our next issue. Send them to dept@math.duke.edu or dkrain@duke.edu

To read about other news, honors and events concerning mathematics at Duke, visit www.math.duke.edu/news/. The on-line calendar at www.math.duke.edu/mcal lists both regular and special seminars and colloquia for the upcoming weeks. The department maintains video archives of talks, lecture series and special conferences at Duke, many of which are available, on-line. See www.math.duke.edu/computing/broadcast.html for more information.

—David Kraines, DMN Faculty Sponsor

FACULTY SPONSOR

David Kraines.....dkrain@math.duke.edu

PRODUCTION MANAGER

Bonnie E. Farrell.....bef@math.duke.edu

Department of Mathematics

Box 90320

Durham, NC 27708-0320

http://www.math.duke.edu/math_news/