

Duke University

Math News

May 12, 2013



• ♦ • SPRING 2013 EDITION • ♦ •

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GRADUATION
EDITION

Class of 2013

After the Commencement Address on Sunday May 12, first majors in mathematics enjoy a fine buffet lunch with their family, fellow graduates and professors in the LSRC dining hall. Math and physics majors receive their diploma in a short ceremony after the luncheon.

After graduation, our math majors will pursue many different avenues such as graduate work in mathematics and other sciences, medical school, law school, computer programming, financial consulting, actuarial activities, secondary education and travel.

They leave Duke with a deep understanding and appreciation of the value of mathematics in modern society. We hope they will log in to the Duke Math News site at http://www.math.duke.edu/math_news/ from time to time to catch up on math news and that they will send us news of major events in their lives.

Undergraduate News

New Courses

Two new courses are being introduced this fall as part of the Focus program in mathematical modeling.

Seminar: MATH 161FS - Mathematics: Introduction to Mathematical Modeling in Biology (R, QS)

Introduction to techniques used in the construction, analysis, and evaluation of mathematical models. How to frame a scientific question in mathematical terms. How to formulate a mathematical

description or representation of the system in question. How to study the model using mathematical tools and techniques. How to interpret the results and put them back into a scientific context. Modeling topics will be taken primarily from biology.

Seminar: MATH 182FS - Mathematics of Finance (QS)

Financial Institutions create financial instruments, known as derivatives, based on underlying assets. A derivative is essentially a contract between the financial institution and the owner of the derivative which dictates future payments between the two parties. The problem, which leads to a central question in financial mathematics, is determining the present price of a derivative. This course is an introduction to the mathematical models used in finance and economics with particular emphasis on models for pricing derivatives, such as options and futures. In this course we want to understand how models are derived from basic economic principles, and provide the necessary mathematical tools for their analysis. As a context for this discussion, we will examine some of the current trading practices in the United States and events that led to the global financial crisis of 2008.

DUMU New Officers

We are happy to introduce the 2013-14 officers of the Duke University Math Union. David Hemminger has been elected president and Daniel Vitek vice president. New officers also include rising sophomores Youzhou Deng as treasurer, Anne Talkington as speaker coordinator and Andrew You secretary. The Duke Math Meet will be organized by Brett Schnobrich, Akshay Save and Alex Milu. Others who will be taking an active role include Yajing Gao and Kathleen Lan.

Special thanks to TongTong Zhan for her excellent leadership of DUMU in 2012-13 and best wishes for

continued success. Her advice will be most welcome by current officers.

Lectures

Among the events sponsored by DUMU, was an enjoyable talk by Professor Bob Palais from Utah University and Utah Valley University. Palais' talk, *Math in Molecular Medicine* explored his research in mathematical microbiology:

Mathematics is being used in many ways to improve the analysis and interpretation of DNA and other molecules that can affect our health. I will describe how math was used to identify genes associated with tumor progression, and to develop methods to identify and quantify genetic variations without expensive and time-consuming sequencing. resulting in a rapid, economical test for transplant compatibility, a cancer therapy, and numerous clinical diagnostic assays. I will also discuss some surprising mathematical connections discovered in the course of this work.

After the talk, several students continued their interaction with Dr Palais over a leisurely dinner.

Mathematics Contest in Modeling

Over 6600 teams of three undergraduates from around the world competed in the international MCM last February. In this 4 day competition, teams of three undergraduates are given open ended math related problems for which they must develop and explore a mathematical model.

The MCM has grown 10 fold in the past decade and competition has thus become far more intense. Of these 6600 teams, 16 were designated as Outstanding and another 20 as Finalists. All four Duke teams were designated as Meritorious, the next highest category. Congratulations to the teams of sophomores Logan Su, Christy Vaughn, and Viggy Vudatha and of David Liu, Ellango Jothimurugesan and Jasmine Wu and the teams of freshmen Anne Talkington, Yilun Gao and Rex Ying, and of Runzhen Ni, Siyang Wang and Ziquan Yang.

Duke has enjoyed a strong record of Outstanding and Meritorious teams over the past several

decades. <http://www.math.duke.edu/news/awards/competitions.html#modeling>

Putnam Competition

Four Duke students received distinguished scores on the 73rd annual W L Putnam Competition held on Saturday, December 1, 2012. Daniel Vitek placed among the top 5% while Michael Banaszek, David Builes and Alex Milu ranked among the top 10%. Each of these students will receive the Menger Award for excellence in math competitions. Fourteen other Duke students competed with most of these ranking among the top quarter of participants.

Duke Math Meet

The 2012 Duke Math Meet took place on Saturday November 10 with nearly 400 high school students participating. For the first time in the Meet's 20 year history, two teams travelled from China and Macao to participate. These teams were organized by Dr. Yong Mao, Associate Director of the International Teenager Competition and the Ministry of Education.

The top individuals this year were Calvin Deng of NCSSM and David Stoner of the Columbia Math Circle. Victoria Xia of Thomas Jefferson HSST, Michael Gao of Bergen Academies and Michael Sun of NCSSM tied for third. The winning teams were from NCSSM, Bergen Academies, Columbia Math Circle and Thomas Jefferson HSST.

Undergrad Research Programs

Nine rising junior and senior PRUV Fellows will spend six weeks this summer working on a math related research project. This research is expected to result in a senior thesis and graduation with distinction in mathematics.

The 2013 PRUV Fellows and mentors are:
 -Jingxing (Rowena) Gan with Ezra Miller
 -David Hemminger with Chris Cornwell
 -Josh Izzard with Jayce Getz
 -Lei (Leslie) Lei with Jianfeng Lu
 -David Liu with Mauro Maggioni
 -Eugene Rabinovich with Ronen Plesser
 -Brett Schnobrich with Robert Calderbank
 -Christy Vaughn with Jonathan Mattingly
 -Alex Wertheim with Les Saper

The NSF sponsored summer program *Structure in Complex Data* has been organized by Paul Bendich and provides stipends for 9 weeks of summer research. The topics for this summer include *Multi-Scale Topology for Signals and Images* and *Time series modelling and dynamical systems with applications in systems Biology*.

The Duke students participating this summer are Eric Hu, Michael Ogez, Anthony Weishampel and Dennis Zhan. Four non-Duke students will also participate. <https://www.mathprograms.org/db/programs/181>.

The Mathematical Biology RTG is now in its third year at Duke. This program supports research grants for undergraduates and mentoring experience for their post-doctoral advisors, a colloquium program with weekly lectures on a topic of general interest, and a week-long workshop for students from (mostly) small colleges.

New postdocs in the program will be Greg Herschlag, a student of Sorin Mitran at UNC who specializes in fluids and biomechanics, and Lydia Bilinsky, a student of Steve Baer at Arizona State in computational neuroscience. She will work on cell metabolism.

The theme of the Fall 2013 colloquium is *PDEs and Biology* and will be organized by Jim Nolen and Jon Mattingly. In Spring 2014, the colloquium will be run by Michael Reed and Lydia Bilinsky on the theme, *Dynamical Systems and Biology*. In Fall of 2014, the colloquium will be run by Anita Layton and Greg Herschlag on the theme, *Fluids and Biology*.

The summer REU for Duke undergraduates will held during the first summer term, May 15 - June 28. For more information, see <http://www.math.duke.edu/mathbio/>

Honors Theses

Seven graduating math majors have written Honors Theses on their mathematical research this year. They have each qualified for Graduation with Distinction in Mathematics.

- Timothy Chang *On the existence of a simple winning strategy in the $T(4,3)$ knot game* with David Herzog
- Conrad de Peuter *Modeling basketball games as alternating renewal-reward processes and predicting match outcomes* with Rick Durrett
- Bryan Jacobson *A practical approximation of persistent local homology* with Paul Bendich

- Kara Karpman *Simulating mucociliary transport using the method of regularized Stokelets* with Anita Layton
- Carmen Lopez *Modeling the folate pathway in *Escherichia coli** with Anita Layton
- Jim Mallernee *Strategy and honesty based comparison of preferential ballot voting methods* with Hugh Bray
- William Zhang *Evolutionary dynamics in host pathogen model* with Rick Durrett

Three current junior PRUV Fellows have finished their honors thesis a year early and plan to pursue other goals during their senior year.

- Xiaoyu Mandy Jiang *Dynamic random network model for human papilloma virus transmission* with Marc Ryser
- Kathleen Lan *Coalescing random walks on n -block Markov chains* with Kevin McGoff
- Jiarou Ivy Shen *Merge times and hitting times of time-inhomogeneous Markov chains* with David Sivakoff

Awards

Faculty Scholar

Daniel Stern '14 has been named one of two Faculty Scholars at Duke for 2013-14. The Faculty Scholar award is the most prestigious given by the faculty to its undergraduates. The criteria for selection include impressively high overall grade point average, independent research, potential for innovative scholarship and intention to pursue a scholarly career.

For nearly two years, Stern has been involved in a major research project with Professor Hugh Bray on an open conjecture involving the positive mass theorem in general relativity. He has mastered a considerable body of advanced graduate level work needed to address this problem and has already made significant contributions. <http://academicouncil.duke.edu/faculty-scholars/>

Karl Menger Award

Daniel Vitek, Michael Banaszek, David Builes and Alex Milu are the winners of the Menger Award given annually for excellence in mathematical competitions. Builes and Milu are first year students. This is the second consecutive prize for Banaszek and Vitek. <http://www.math.duke.edu/news/awards/menger/index.html>

Julia Dale Prize

The Julia Dale winners for 2013 are Bryan Jacobson and Kara Karpman. Both have excelled in graduate level math courses and have completed major research projects. They plan to continue their studies in Ph.D. graduate math programs, Jacobson at Vanderbilt and Karpman at Cornell.

Five years ago, the Julia Dale Prize was extended to recognize truly exceptional first year students in mathematics courses. We are most pleased to have a record nine students with superb records: Lindsey Shoemaker Brown, David Builes, Kyle Casey, Kim Lien Hoang, Alex Milu, Michael Ogez, Will Victor, Zhitao Rex Ying, and Ziquan Yang. We wish each continued success as mathematics majors.

Julia Dale taught at Duke for several years before her untimely death in 1936. Friends and relatives established a fund in her name to honor the most distinguished students in mathematics. <http://www.math.duke.edu/news/awards/dale/index.html>

Graduate Student News

Graduating Ph.D. Students 2012-2013

Congratulations to the following graduate students who are receiving the doctorate in mathematics:

- Hyeongkwan Kim

Thesis: *Gersten-Witt complex of Hirzebruch surfaces*, Advisor: William Pardon

- Yi Li

Thesis: *Numerical methods for simulating fluid motion driven by immersed interfaces*, Advisor: Anita Layton

- Shishi Luo

Thesis: *Probabilistic methods for multiscale evolutionary dynamics*, Advisor: Mike Reed

- Elizabeth Munch

Thesis: *Applications of persistent homology to time-varying systems*, Advisor: John Harer

- Alan Parry

Thesis: *Wave Dark matter and dwarf spheroidal galaxies*, Advisor: Hubert Bray

Faculty News

Robert Bryant

Robert Bryant, J.M. Kreps Professor of Mathematics, returns to Duke after completing his five-year term as Director of the Mathematical Science Research Institute in Berkeley CA. He is a fellow of the American Academy of Arts and Sciences and a member of the National Academy of Sciences.

Ingrid Daubechies

Ingrid Daubechies has been honored with the BBVA Foundation Frontiers of Knowledge Award for work that has “strongly influenced diverse fields of applications, ranging from data compression to pattern recognition”.

This award is sponsored by Banco Bilbao Vizcaya Argentaria, a multinational banking group, and is given for outstanding contributions to scientific research and artistic creation or analysis and/or material progress in the spheres of Climate Change and Development Cooperation.

Daubechies shares the Basic Science Award with David Mumford. For more, see <http://www.fbbva.es/TLFU/tlfu/ing/microsites/premios/fronteras/galardonados/2012/ciencias.jsp>

Anita Layton

Anita Layton has been selected as a Bass Fellow, a Duke named professorship awarded for her excellence in both research and teaching at Duke.

In addition, she has received a grant from the Bass Foundation for developing a *Modeling and Simulations Team* with Nick Gessler from ISIS. Team activities, which will begin in the fall of 2013, include the Focus cluster, a spring Bass Connection Seminar course, and a modeling and simulation contest (see page

1). See <http://www.interdisciplinary.duke.edu/bass-connections>

Jianfeng Lu

Jianfeng Lu has been selected as a 2013 Alfred P. Sloan Fellow. This Fellowship seeks to stimulate fundamental research by early-career scientists and scholars of outstanding promise. They are awarded yearly to 126 researchers in recognition of distinguished performance and a unique potential to make substantial contributions to their field. <http://www.sloan.org/sloan-research-fellowships/>

Arlie Petters

Arlie Petters has been named one of the top college science and technology professors in North Carolina by the On-line Schools of NC organization. <http://onlineschoolsnorthcarolina.com/top-college-professors-in-north-carolina/science-technology/>

The American Mathematical Society has named 14 Duke faculty members as Fellows, citing their outstanding contributions to the creation, exposition, advancement, communication and use of mathematics. Our distinguished AMS faculty include math professors J. Thomas Beale, Hubert Bray, Robert Bryant, Robert Calderbank, Ingrid Daubechies, Richard Durrett, Richard Hain, Mauro Maggioni, Ezra Miller, Arlie Petters, Michael Reed, Leslie Saper, David A. Smith and Mark Stern.

Mary Ellen Rudin, 1924-2013, former Duke instructor and renowned Topologist and Problem Solver, passed away this spring. Mary Ellen was hired to teach at Duke University's Women's College shortly after finishing her thesis in 1949 under R. L. Moore.

Walter Rudin, 1921-2010, had entered Duke soon after WWII ended to finish his undergraduate students. He earned his B.A. in two years and his Ph.D. two years after that. He was an instructor when Mary Ellen arrived. A few years later, they married and eventually settled at the University of Wisconsin where each had a long and distinguished career.

Math Degree Candidates, Academic Year 2012–13

First Majors

Mr. Michael Christopher Banaszek
 Ms. Diana A. Bramson
 Mr. Darius Rudnyckyj Brown
 Mr. Timothy Hyunjin Chang
 Mr. Thomas Byron Clark
 Mr. Conrad L De Peuter
 Ms. Lauren Alessandra DeGirolamo
 Mr. Theodore Frederick Force
 Mr. Zhen Gou
 Mr. Andrew Carl Hertzberg
 Mr. Bryan Jeffrey Jacobson
 Mr. Wonjo Jang
 Mr. Michael Joseph Jerome
 Ms. Kara Juliette Karpman
 Ms. Julene M Latter
 Ms. Juanyi Li
 Ms. Carmen Victoria Lopez
 Mr. James M Mallernee
 Mr. Benjamin Tyler Meiseles
 Mr. Faiyam Habib Rahman
 Mr. Xiaochuan Sha
 Mr. Eric Burrell Sorensen
 Mr. Constantine Stoumbos
 Mr. Andrew Jackson Walker
 Mr. Chaoxiong Xu
 Mr. Afanasiy Sergeevich Yermakov
 Mr. Liwei Zhang
 Mr. William B Zhang
 Ms. Yichun Zhao

Second Majors

Ms. Elena Dolores Botella
 MR. Hanyang Cao
 Ms. Lauren Alicia Dixon
 Mr. Nicholas Anthony Gillum
 Mr. David Hong
 Mr. Joseph A La Barbara
 Mr. Carl Erik Lawson
 Mr. Max Zesheng Li
 Mr. Joshua Daniel Loyal
 Mr. Zongjin Qian
 Mr. Tianxiang Xiong
 Mr. Dazhong Xuan
 Ms. Shutong Zhan

Minors

Mr. Benjamin Samuel Berg
 Mr. Yifei Chen
 Mr. William Kennedy DiClemente
 Mr. Bradley Harris Ezratty
 Mr. Spencer Drew Fallek
 Ms. Taylor Elizabeth Gill
 Mr. John Samuel Greenberg
 Ms. Julia Katharina Hoos
 Mr. Kevin Jye Jen
 Ms. Yan Jia
 Mr. Steven Joshua Jones
 Mr. Jordan Eli Kassof
 Mr. Stephan Luis-Javier Lambert
 Ms. Linda Li
 Ms. Heehyun Lim
 Mr. Winston James Neville
 Mr. Brian G Norton
 Mr. David Mestier Short
 Mr. Gregg Brelsford Thawley
 Mr. William Harrington Weir

Master of Arts

Mr. Humberto Antonio Diaz
 Mr. Brian David Fitzpatrick
 Mr. Christopher David O'Neill

Doctors of Philosophy

Dr. Hyeongkwan Kim
 Dr. Yi Li
 Dr. Shishi Zhige Luo
 Dr. Elizabeth Anne Munch
 Dr. Alan Reid Parry

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 <http://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 <http://www.math.duke.edu/news/>. The on-line calendar at <http://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 <http://www.math.duke.edu/computing/broadcast.html> for more information.

—David Kraines, DMN Faculty Sponsor

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