
THE N.C. STATE UNIVERSITY UNDERGRADUATE MATHEMATICS NEWSLETTER



Meet Jonathan Hauenstein

Dr. Jonathan Hauenstein is a new assistant professor in the Math Department. He joins us after postdoctoral positions at the Fields Institute in Toronto, Canada, the Mittag-Leffler Institute in Djursholm, Sweden, and Texas A&M University. He moved to the Raleigh suburb of Holly Springs this summer with his wife of seven years Julie and their three daughters, two year old twins Morgan and Leah, and one year old Kristyn.

Growing up on a small farm outside of the village of Arcadia, in northwest Ohio, Dr. Hauenstein raised chickens and played soccer throughout his youth. As the valedictorian of his high school class, he earned a full academic scholarship to attend The University of Findlay. While at Findlay, Dr. Hauenstein explored becoming an engineer while also entertaining interests in computer science and mathematics. During the many tutoring sessions he conducted with students, he realized his love for teaching. Facilitated by the departure of his engineering advisor from Findlay, he switched to mathematics, graduated from Findlay in 2003, and further pursued his mathematical studies at Miami University in Oxford, Ohio. While at Findlay, Dr. Hauenstein met his future wife who graduated from Findlay with a degree in physical therapy.

During his tenure at Miami, Dr. Hauenstein taught many courses and discovered the rewards of research by studying the advantages and disadvantages of various optimization algorithms he implemented. This combination of algorithms and implementation persists in his research today. The summer of 2005 was an extremely busy time for Dr. Hauenstein: he finished his Master's degree at Miami, participated in a summer research program at Miami on algebraic geometry funded by the National Security Agency, married his wife, and moved to South Bend, Indiana to begin his Ph.D. studies at the University of Notre Dame. He even studied for his written qualifiers on their honeymoon cruise in the Bahamas (the studying was rewarded since he passed the qualifiers upon entrance at Notre Dame).

While at Notre Dame, Dr. Hauenstein met Dr. Andrew Sommese whose research involved developing numerical methods in algebraic geometry with applications in robotics in collaboration with Dr. Charles Wampler at General Motors Research & Development. Dr. Hauenstein has continued researching this area of mathematics after earning his Ph.D. in 2009 by developing many new algorithms, creating software packages for him and others researchers to use for studying the roots of polynomial systems, and exploring new applications in biology, chemistry, engineering, physics, and statistics.

Mathematics has permitted Dr. Hauenstein to travel and give lectures around the world, and meet with researchers in many areas of science and engineering. He tries to include his wife and daughters in his travels, most notably living in Stockholm, Sweden for a semester when the twins were less than a year old. His family is already looking forward to their next big trip: the Fall 2014 program on "Algorithms and Complexity in Algebraic Geometry" at the Simons Institute for the Theory of Computing in Berkeley, California.

In his spare time, Dr. Hauenstein spends time with his family visiting the local parks and walking trails. A few times a year, he is able to squeeze in a round of golf.

COURSE HIGHLIGHTS

MA 537, "NONLINEAR DYNAMICS AND CHAOS"

Prerequisite: MA 341 and MA 405

In recent years there has been an explosion of interest in nonlinear behavior, chaos, and fractals in the physical and biological sciences. Chaotic behavior has been observed in disciplines as diverse as meteorology, medicine, and economics. These phenomena may be introduced at an elementary level because often they are described by nonlinear difference equations, which are discrete dynamical systems and are analyzed by studying iteration of functions. The course will introduce appropriate mathematical concepts, e.g., equilibrium, stability, bifurcation, and fractals. Software will be available so that students can perform computer experiments and discover for themselves the fascinating behavior of nonlinear dynamical systems.

MA 544: Comp. Experiments in Mathematical Probability

Prerequisite: MA 421

Explore the benefits of using computers to gain insight into mathematical behavior. Examples will be chosen from topics in probability theory which are not typically covered in other courses or which do not have a complete mathematical treatment at this time.

For further information go to

www.math.ncsu.edu/~jack/ma544.html.

MA 522 Computer Algebra

Prerequisites: linear algebra and abstract algebra

The course covers the foundations of the discipline of symbolic computation. It can help undergraduate students in their applications to graduate programs in pure and applied mathematics and in computer science.

www4.ncsu.edu/~kaltfen/courses/ComputAlgebra/Fall09/ for the 2009 edition of the course.

MA 493/BIO 495: Mathematical Modeling Techniques for Biological Systems

Prerequisite: One year of calculus (MA 341 desirable)

This course seeks to provide students with a fundamental understanding of how mathematics and statistics are applied to problems in life sciences. Our approach will be through several "case studies" problems, which arise, in biological applications. For each case study we will discuss why a model is needed and what goals are to be sought. We

will examine the mathematical models both analytically and computationally in order to compare their behavior with that exhibited by the modeled phenomena. Such a comparison can be achieved quantitatively through model verification and validation, which are central to the process of model development and evaluation for all complex systems. In particular, verification concerns with building the model right. It is utilized in the comparison of the mathematical model to its computer implementation. On the other hand, validation concerns with building the right model. It is utilized to determine that a model is an accurate representation of the real biological system.

This course is part of a new undergraduate biomathematics (UBM) initiative at NC State

(<http://www4.ncsu.edu/~allloyd/ma493/UBM.html>).

MA 493/591: Linear Matrix and Differential Operators

Prerequisites: C or better in MA 205 or equivalent

Builds on matrix calculations for solving $Ax = d$ where A is $m \times n$. General inner product spaces, basis and four fundamental spaces. Orthogonal vectors and functions, Gram-Schmidt and QR factors. Eigenvalues for linear operators, linear IVP, adjoint operators and Sturm-Liouville BVP. SVD, least squares and image compression. Haar transform and introduction to wavelets. Fourier transform, filters and Poisson solvers. Students who enroll in the graduate level MA 591 will be required to do a project related to the above applications.

<http://www4.ncsu.edu/eos/users/w/white/www/white/ma205/Special%20Two.pdf>

MA/BMA/ST 772: Biomathematics II:

Prerequisite: Although nominally a graduate course, the course is open to advanced undergraduates with a solid background in probability (ie, MA 421 or an equivalent)

Stochastic Modeling in Biology Stochastic models provide a useful and rigorous framework for analyzing natural phenomena subject to randomness. In this class, we study several stochastic models and emphasize their application to various realms of biology. Mathematical content includes both discrete- and continuous-time Markov processes, branching processes, counting processes, and diffusion processes. Areas of biological application include disease modeling, genetic drift, molecular evolution, and population dynamics. Special attention is paid to implementing computer simulations of Markov processes and to engaging the current scientific literature. Note: It is not necessary to have taken BMA 771.

Advanced Mathematics Courses**The following classes may be used as advanced math electives in the Spring 2013**

MA 325: Introduction to Applied Mathematics
MA 401: Applied Differential Equations II
MA 408: Foundations of Euclidean Geometry
MA 410: Theory of Numbers
MA 412: Long-Term Actuarial Models
MA 416: Introduction to Combinatorics
MA 421: Introduction to Probability
MA 426: Mathematical Analysis II
MA 428: Intro. to Numerical Analysis II
MA 432: Mathematical Models in the life & Social Sciences
MA 437: Applications of Algebra

MA 493/ BIO 591: Mathematical Modeling Techniques for Biological Systems
MA 493/591: Linear Matrix and Differential Operators
MA 501: Advanced Mathematics for Engineers and Scientists I
MA 512: Advanced Calculus II
MA 513: Introduction to Complex Variables
MA 537: NonLinear Dynamics and Chaos
MA 544: Computer Experiments in Mathematical Probability
MA 724: Combinatorics II
MA/BMA/ST 772: Biomathematics II

**News from the Math Honors Program
By Dr. Sandra Paur**

Twelve students completed the Math Honors Program in May and this summer, including Taylor Allison, Kevin Barkett, Yeou Chiou, Jeff Fowler, Jeff Gory, Aaron Marcus, Sean Reynolds, Wesley Stewart, Chris Thunes, Chong Wang and Tim Wessler. Taylor and Tim are doing PhD work in math at UNC, Kevin is working on a PhD in physics at Cal Tech and Yeou is doing PhD work in physics at NC State. Jeff Gory is at The Ohio State University in Statistics, Chong Wang is at NC State in Statistics and Wesley is at the Institute for Advanced Analytics at NC State. Sean is finishing up the BS/MS program in ECE, while Jacob, Jeff and Chris are employed.

New students in the program include Laura Barnobi, Nick Dunn, Patrick Gallagher, Cody Melton, Robert O'Brien, Chris Paquette, Faye Pasley, Nick Quayle and James Rowland. Thirty-six students are currently participating in the Math Honors Program and invitations to join the program will be extended sometime during pre-registration. Every year approximately 20-25% of math graduates complete the Math Honors Program and about 80% of those students go on to graduate school. Schools they have attended include Berkeley, Princeton, Stanford, MIT, Cornell,

NYU and UCLA. Math honors students have received 13 NSF Fellowships and four DoD Fellowships for graduate school as well as six Goldwater Scholarships and two Gates Fellowships. Besides taking more challenging courses to complete their math degrees, Math Honors Program students also do research either at NC State or in a summer Research Experience for Undergraduates (REU).

More than 30 students have completed a study abroad program focusing on mathematics, either at the Budapest Semesters in Mathematics (BSM) or the Math in Moscow Program, including Alex Chin, who did the Budapest Semesters last semester. Participation in REUs, BSM and similar programs has played a major role in the success of our students in getting accepted into excellent graduate schools. Dr. Paur is happy to talk to any student interested in participating in the Math Honors Program –stop by her office in SAS 3144 or email her at sopaur@math.ncsu.edu for an appointment.

More information about the program can be found on the Math Honors website at www.math.ncsu.edu/honors

SUM Series -Math and pizza!

The SUM Series features informal talks on mathematical topics. The talks are held Wednesdays from 4:00 to 4:50, in 2102 SAS Hall. You will have a few minutes to help yourself to pizza before the talk. For upcoming topics, check out the SUM Series website: go.ncsu.edu/sumseries. There is a low volume (weekly) email list dedicated to announcements of upcoming SUM Series talks. Instructions for joining the list are on the website.

Research Opportunities By Dr. Molly Fenn

Mathematics students who are interested in participating in undergraduate research have several options. By seeking out a faculty mentor, students can begin working on research during the academic year. If you are interested in doing this, talk with your professors, attend talks in the department that sound interesting, check out the research interests of faculty using the department website, and talk to your peers. These are great ways to find faculty members who might have a project that interests you.

Another exciting opportunity to participate in undergraduate research is through a summer Research Experience for Undergraduates (REU) program. These programs occur at universities around the country. They usually involve working on a project with a small group of other undergraduates under the direction of faculty mentors. These programs pay students a stipend for the summer and often include housing costs and some help with travel and meal expenses. Deadlines to apply for REU programs are usually in February.

If you are interested in hearing undergraduates talk about their research, or if you want to present research you've done in the past, consider attending the Regional Mathematics and Statistics Conference at UNC Greensboro on November 3rd. The deadline for registration is October 12th. Registration is free. For more information, search for UNCG Math Conference or see the flier in the UG math lounge, 2202.

UMB PROGRAM

Funded by the National Science Foundation, the UBM program offers you the chance to carry out cutting-edge research at the interface of mathematics and biology. Eight students a year, four from the mathematical sciences and four from the biological sciences, will receive summer support as part of a year-long research experience. MA 493 (Fall semester) and its sister course MA 493/BIO 495 (Spring semester) are designed to prepare biology/mathematics students for the research component of the UBM program.

See course highlights for class information



Having Fun with Math!

Number of Divisors

Problem provided by the Editor

Let a, b and c be positive integers greater than 50 such that one of them has an odd number of positive divisors and the other two each have exactly 3 positive divisors. If $a + b = c$, find the values of a, b and c such that c is as small as possible.

Evaluate the sum

Problem provided by the Editor

Let a be a positive number such that $a^{2012} - 7a + 6 = 0$. Find all possible values of the sum $S = 1 + a + a^2 + \cdots + a^{2011}$.

For the Answer Visit:
www.math.ncsu.edu/undergrad/newsletter/

Congratulations

Students Win Poster Prizes

Four of the eight poster prizes at the 2012 Society for Industrial and Applied Mathematics Conference on the Life Sciences went to students associated with NC State. The two undergraduate prizes went to NC State senior Joseph Arthur for work with Professor Hien Tran on modeling Hepatitis C viral dynamics, and to Cal Poly Pomona undergraduate Alberto Soto for work done in an NC State summer research program with Professor Mette Olufsen on modeling blood pressure dynamics.

Two of the six graduate student awards went to Allison Margolskee for work with Professor Jim Selgrade on modeling hormonal regulation of the menstrual cycle, and to William Cousins for work with Professor Pierre Gremaud on hemodynamic modeling. Margolskee and Cousins are graduate students in the NC State Mathematics Department.

UNDERGRADUATE PROGRAM

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