MATHEMATICS NEWSLETTER

NEWS FOR THE UNDERGRADUATE

Mathematics Advanced Study Semesters

By Patrick Barrow

The MASS Program at Penn St. University is a semester long undergraduate transfer program geared towards students preparing for graduate study in mathematics. It combines classroom study with independent projects, as well as weekly guest lectures on modern research topics. If you are considering either an REU or the Budapest program, MASS provides a North American alternative. How do I know all this? I just completed the fall semester with 14 MASS 2002 participants from across the country. Aside from the intense and fast paced exposure to various topics in modern mathematics, it was an opportunity to meet and work with other students sharing an interest in the subject. It is anything but the traditional classroom experience; oral communication is emphasized, as is independent investigation. We even had our own classroom/lounge and our own hall in the dorms. If a highly difficult yet rewarding semester studying only math sounds good to you, then MASS is perfect.

I would be happy to talk with anyone interested in applying.   email: pfbarrow@unity.ncsu.edu
        Or visit www.math.psu.edu/mass/

"Mathematics is the tool specially suited for dealing with abstract concepts of any kind and there is no limit to its power in this field"

Paul Adrien Maurice Dirac
(1902—1984)

Mathematics Electives

These classes may be used as Advanced Math Elec. (GRP 002).

SUMMER 2003
MA 401 ....Applied Differential Equations II
MA 421 ....Intro. to Probability
MA 501 ....Adv. Mathematics for Engineers and Scientists I
MA 502 ....Adv. Mathematics for Engineers and Scientists II
MA 513 ....Intro. to Complex Variables

FALL 2003
MA 351 ....Introduction to Discrete Mathematical Models
MA 401 ....Applied Differential Equations II
MA 402 ....Computational Math: Models, Methods & Analysis*
MA 408 ....Foundations of Euclidean Geometry
MA 421 ....Intro. to Probability
MA 422 ....Long-Term Actuarial Models*
MA 426 ....Mathematical Analysis II
MA/CSC 427.....Introduction to Numerical Analysis I
MA 430 ....Mathematical Models in Physical Sciences*
MA 493R...........Putnam Seminar
MA 501 ....Adv. Math for Engineers & Scientists I
MA/OR 504.......Introduction To Mathematical Programming
MA 505 ....Linear Programming
MA 509 ....Abstract Algebra for Secondary Teachers
MA 513 ....Intro. to Complex Variables
MA 515 ....Analysis I
MA 518 ....Intro. to Manifold Theory
MA 520 ....Linear Algebra
MA 521 ....Abstract Algebra I
MA 522 ....Computer Algebra
MA 523 ....Linear Transformations & Matrix Theory
MA/OR 531.......Dynamic Systems and Multivariable Control I
MA 532 ....Ordinary Differential Equations I
MA 534 ....Intro. to Partial Differential Equations
MA 535 ....Stability & Time Opt. Control of Hered. Sys.*
MA/ST 546........Probability and Stochastic Processes I
MA 551 ....Intro. to Topology Processes I
MA/BMA 573 ....Mathematical & Experimental Mod. of Phys. Proc. I*
MA/CSC 580.....Numerical Analysis I
MA 584 ....Num. Solu. of PDEs—Finite Difference Methods
MA 591K...........C/C++/Java for Mathematicians
MA 591O ....Interacting Particle Systems

*These classes may be used for the math modeling requirement for AMA majors (OPT 001).

Class times are listed at www.math.ncsu.edu/Courses/Sprg03.txt.

Inside this issue

ANNOUNCEMENT: The Undergraduate Office has created a "Career Notebook." This notebook will contain information on internships, job opportunities, math-related events, and more. The Undergraduate Mathematics Career Notebook is available in Harrelson 255.

To place information send to return address on page 6.

Summer Graduates

Walter Rockwell Boyle ....*Applied Mathematics*
Corrie Randolph Camalier ....*Applied Mathematics*
Ahmad Jamal Harvey.....................*Applied Mathematics*
Robert Scott Martin ....*Applied Mathematics*

Meltem Huryasar ....*Mathematics*
Meghan Sue O'Malley ....*Mathematics*
Brian C. Smith..*Mathematics*
Danny W. Spell...*Mathematics*

Fall Graduates

Joseph Daniel Allen ....*Applied Mathematics*
Michael Cornelious Dukes ....*Applied Mathematics*
Franklyn Gonzalez, II ....*Applied Mathematics*
Jamal Anton Heyward...................*Applied Mathematics*
Mengning Liang ....*Applied Mathematics*
Jessica Loock Matthews ....*Applied Mathematics*
Shashank S. Pandit ....*Applied Mathematics*
Bradley Dale Parsley ....*Applied Mathematics*
Mary Elizabeth Pearce..................*Applied Mathematics*

Arthur William Peterson, III ....*Applied Mathematics*
Jason Matthew Turner...................*Applied Mathematics*
Joseph Cranston Wagner..............*Applied Mathematics*
Mark Daniel Aldrich.....................................*Mathematics*
Trang Thien Dao...*Mathematics*
Ann Helene Goodwin...................................*Mathematics*
Katherine Marie Morse ....*Mathematics*
David Mark Sherson ....*Mathematics*

Andrea Hernandez: Pack Leader

The Math Department would like to congratulate Andrea Hernandez on her Leader of the Pack award. Candidates are usually involved in leadership roles and have good academic standing. Andrea is co-founder and president of Mi Familia, an Ethnic/Multicultural student group. More Pack info at students.ncsu.edu/lop/index.php

Scholarship Awardees

Departmental Scholarships are awarded several times throughout the year and based on academic accomplishment as measured by grade point average, adequate progress towards a degree in mathematics, and difficulty of the courses taken, and sometimes financial need. Forms are available at www.math.ncsu.edu/undergrad/scholarships. *We would like to recognize math majors who have received scholarships this academic year:*

Fund For Excellence: John Chester, Robert Darwin, Lynn Harris, Jessica McCoy, Shawanna Norman, Kristen Ricks

Anderson Scholarship: William Morgan, II

Aspnes Scholarship: Mary Katherine Baker, Victoria Moultrie

Dr. Bullock Scholarship: Dmitri Morozov

Mrs. Bullock Scholarship: Steven Farrar

Cell Scholarship: Robert Futrell, Christopher Goulette

Chaney Scholarship: Christopher Goullette

CSEMS: Eliza Britt, Justin "Chris" Flake, Jeremy Maness

Fall 2002 Senior Awards Nominees

The College Senior Awards recognizes outstanding graduating seniors in three categories: Scholarly Achievement, Research, and Leadership. The Final selection is made by PAMS college administration. The following students were nominated by the Math department.

Scholarly Achievement
Jessica Matthews
Research
Shashank Pandit
Leadership
Shashank Pandit

Duke Energy: Osama Alia, Shashank Pandit, KeTrena Langhurst, Mark Sutton

Mumford Scholarship: Andrea Hernandez

Math Endowment: Dylan Ascolese

Park Scholarship: Eliza Britt, Heather Cherry

Petrea Scholarship: Frank Goldsmith, Jessica Matthews

Whitten Dean's Scholarship: Ashley Arnold, Andrea Hernandez

Caldwell Fellows
Heather Cherry, Jonathan McDaniel, David Johnson, Brad Parker, Jessica King, Jessica Wagstaff, Jessica McCoy

Park Scholars
Amanda Albert, Justin Brockman, Matthew Campbell, Robert Campbell, Mark Darby, Joshua Hines, Jerome Hodges IV, Erik Johnson, Tania Jones, Margaret Linak, Timothy Mowrer, Benjamin Tennant, Maya Thompson, Nicholas Vance, Donald Warren, III

Careers in Mathematics: Rebecca Segal

Post Doctoral Fellow in Division of Biomathematics and Physical Sciences at CIIT Centers for Health Research

By Rebecca Segal

Ever since I attended a summer research program after my junior year where I heard a mathematician describe her efforts to model HIV and the effects of a new drug on the disease, I knew that I wanted a career with a biological emphasis. I went on to graduate school at NCSU and got a Ph.D. in Applied Mathematics.

I work on computational fluid dynamic models of airflow in the nose. The purpose of this work is to have a basis for modeling gas uptake of inhaled toxic gases (such as formaldehyde and ozone) for the purpose of environmental regulations. The flow simulation results are also paired with particle deposition simulations to study the effectiveness of nasal drug delivery devices. The areas of mathematical knowledge I refer to most are fluid dynamics, partial differential equations and numerical analysis. Strong computer skills are important, as I interact daily with up to seven different commercial software packages as well as six different in-house codes written in languages such as MatLab, Fortran, C++, and Visual Basic. My job involves analytical thinking more than explicit 'math' work. I am not required to do any proofs but rather to determine how best to model a complex biological system to extract as much information as possible.

I work with people who have degrees ranging from bachelors to masters to doctorate and we all work on the same general project. The main difference is that with a Ph.D., I get to work on all aspects of the project from model design to simulations to analysis and validation of the results. I interact daily not only with other mathematicians, but also with biologists and physicists who provide invaluable insight into the problems I am tackling. The work is challenging and I know that ultimately the research I am doing will lead to better air quality control and more effective medical devices.

More CIIT info. at www.ciit.org.
Email Rebecca at RSegal@ciit.org.

Phi Beta Kappa

Math students initiated Fall 2002 were:

Mark Christopher Harris
Kelly V. Lancaster
Timothy D. Mowrer

> *"No human investigation can be called real science if it cannot be demonstrated mathematically"*
>
> -Leonardo da Vinci

Can You Solve This?

This issue's problem comes from Dr. Erich Kaltofen

1. Given four distinct parallel planes, prove that there exists a regular tetrahedron with a vertex on each plane.

Please submit answers to Bisa Meek in HA 255.

2002 Virginia Tech Regional Mathematics Contest

Each year some of our best undergraduate students take the annual VTRMC math contest. The VTRMC participants included 41 schools totaling 248 participants. The maximum score was 70. Only 6 students scored 50 and above, 18 scored 30 to 49. Our group did well in last year's VTRMC contest.

NC State Mathematics Major, Chris Lipa, Ranked 5th in a tie with Univ. of Central FL student. His score was 50 out of 70. Chris is also completing a degree in Computer Science.

VTRMC info: www.math.vt.edu/events/
Dr. Lin: xblin@math.ncsu.edu.

More contest info:
www.math.ncsu.edu/undergrad/ncsu_contests/

Todd Fuller High School Mathematics Competition

Twelve high schools (total of 81 students) from Wake county participated. Leesville Road High School came in 1st place by 5.5 points. Leesville Road also had students placed 1st, 3rd (tie), and 4th (tie).

We are pleased to have Todd Fuller as the 2002 sponsor. Todd Fuller graduated from NCSU with a major in mathematics. He had an outstanding academic record and also was a star on the Basketball Team. Todd went on to a successful career in professional basketball. More history on the competition can be found at www4.ncsu.edu/~njrose/Special/history.html. From 1996 to 2001 the contest was sponsored by the College of PAMS and was called the NC State University Mathematics Competition.
More info:
www.math.ncsu.edu/undergrad/ncsu_contests/

Honors News

By Sandra Paur

Two students, Mengning Liang and Joseph Wagner, completed the Math Honors Program in December 2002. Meng is planning on going on to grad school in physics and Joe is going on to grad school in math. Three students, Trena Langhurst, Jessica McCoy and Brian Pike joined the honors program last semester.

Pat Barrow has returned from study at the Mathematics Advanced Study Semesters (MASS) program at Penn State and Jason Blevins is back from the Budapest Semesters in Mathematics. Both Pat and Jason were very pleased with their programs. In addition, Jay Hodges is currently in Budapest and says he's having a great time. In the last 10 years, 17 honors students have done study abroad, with 10 of those students participating in the Budapest Semesters.

Students participating in the Math Honors Program are also encouraged to do math research at NC State and in summer programs such as the NSF sponsored Research Experiences for Undergraduates (REU'S). In the last 10 years,

Solutions to *Fall 2002 Can You Solve This?*

1. Let P_1 and P_2 be regular polygons of 2002 sides and perimeters *x* and *y* respectively. Each side of P_1 is tangent to a given circle of circumference *c* and this circle passes through each vertex of P_2. Prove that $x + y \geq 2c$.

    Solution: Danny Spell, an NCSU alumnus, was the only one to submit a solution to this problem. He noted that $x = 2002(\sin(\pi/2002) \cdot c/2\pi)$ and $y = 2002(\tan(\pi/2002) \cdot c/2\pi)$. He then showed that for $0 \leq \theta < \pi/2$, you have $\sin\theta + \tan\theta \geq 2\theta$. (The conclusion of the problem follows from this inequality). Danny proved this inequality using series expansions for sin and tan. It can also be proved using the Mean Value Theorem. The inequality can be proved without calculus using some tricky trig: let $t = \tan(\theta/2)$. Then

    $$\sin\theta + \tan\theta = \frac{2t}{1+t^2} + \frac{2t}{1-t^2} = \frac{4t}{1-t^4} \geq 4t \geq 2\theta.$$

2. Determine the function $F(x)$ which satisfies the functional equation $x^2 F(x) + F(1-x) = 2x - x^4$ for all real x.

    Solution: Replacing *x* by $1-x$ gives $(1-x)^2 F(1-x) + F(x) = 2(1-x) - (1-x)^4$. Solving this and the given equation simultaneously for $F(x)$ gives $F(x) = 1 - x^2$.

    > *Solutions courtesy*
    > *Dr. Bob Ramsay*

3. Prove that if $x + \dfrac{1}{x} = 2\cos\alpha$, then $x^n + \dfrac{1}{x^n} = 2\cos n\alpha$.

    Solution: This problem was solved by Ralph Craig, an NCSU graduate student, and by Alex Thannikkaky, a Math Instructor at Halifax Community College. Both Alex and Ralph used mathematical induction. Here is an alternate solution using complex arithmetic: The assumption above can be written as $x^2 - 2x\cos\alpha + 1 = 0$, so by the quadratic equation, $x = \cos\alpha \pm i\sin\alpha$. Thus by De Moivre's theorem, $x^n = \cos n\alpha \pm i\sin n\alpha$, and $\dfrac{1}{x^n} = \cos n\alpha \mp i\sin n\alpha$. Adding these to gives the desired conclusion.

Course Advertisements

Introduction to Parallel Computing
MA/CSC 583, www4.ncsu.edu/eos/users/w/white/www/white/bob.html
Prereq. CSC 302 or MA 402 or MA/CSC 428 or MA/CSC 580

Introduction to basic parallel architectures, algorithms and programming paradigms; message passing collectives and communicators; parallel matrix products, domain decomposition with direct and iterative methods for linear systems; analysis of efficiency, complexity and errors; applications such as 2D heat and mass transfer. The first half of the course will introduce the basic message passing interface (MPI) subroutines. The second half will use MPI to solve linear systems via direct and minimized iterative methods. This class will be offered in spring 2004, so be sure to take the prerequisites in Fall 2003.

Introduction to Computational Science
MA 293G, www4.ncsu.edu/~scroggs/MA293G
Co-requisite MA 241
Satisfies Computer Science Requirement for MA and AMA (GRP 003)

Use of Matlab to solve science and engineering problems. Topics include use of arrays, files, subroutines, and data structures, as well as visualization and numerical methods. Comparison with modern computing languages will be included as time permits. Direct questions and inquiries to Prof. Scroggs (scroggs@math.ncsu.edu).

Mathematical Biology

How is a disease transmitted through a population? How do Malaysian fireflies synchronize their lights with each other? How often should a patient get chemotherapy? How does a cell pinch itself in two? If you've ever wanted to answer a biological question with a mathematical answer, perhaps you should try a course in mathematical biology. Mathematical biology encompasses all of biology and most of mathematics. There are several courses in mathematical biology at NCSU, which can count as applied math electives. If you are an upper-level math major who has had some biology courses, you are prepared for these courses:

MA 432: Mathematical Models in Life and Social Sciences (pre. MA 301 or 341, 305 or 405, programming language)
BMA 567: Modeling of Biological Systems (pre. MA 131)
MA/BMA 573 or **574:** Mathematical & Experimental Modeling of Physical Processes I, II (pre. MA 341, MA 405, programming language)
MA/BMA/ST 771: Biomathematics I (pre. MA 241, MA 305 or 405, and some biology)

HONORS *(Continued from page 4)*
22 math majors have done summer REU's at schools including Rutgers, U of Illinois, Lafayette College, Hope College, Rose-Hulman, Oregon State, Florida State, Colorado School of Mines, Penn State, U of Washington, U of Puerto Rico, and Indiana. As a result 9 students have received NSF Fellowships for graduate study. In fact, for NSF Fellowships in math since 1994, we're ranked 12th nationally, tied with Harvey Mudd, U of Chicago, U of Illinois at Chicago and U of Washington. Graduate schools attended by our students include Princeton, MIT, Stanford, NYU, Cornell, Wisconsin, Rutgers and several other schools.

Last semester three students, Luke Cherveny, Chris Flake and Joseph Wagner presented results of their research to math faculty and students. Luke's presentation was entitled "Reduction Junction: What's Your Function" and was a result of his REU work last summer at Trinity University. Chris talked about a "Mathematical Model for a Predator-Prey System Involving Disease", based on his REU work at University of Nebraska, Lincoln and Joe presented work he had done with Dr. Franke, entitled "Applying the Ott-Greborgi-Yorke Method of Controlling Chaos". We expect several students to be presenting results of their research this semester. Times and places will be announced.

Twenty-nine students are currently participating in the Math Honors Program and invitations to join the program will be extended sometime during pre-registration. Students interested in more information about the program should contact Dr. Paur, HA 202, 515-2598, sopaur@math.ncsu.edu or check out the honors program web site; www.math.ncsu.edu/honors.

Faculty Announcements

(NEW) Emily Mann Peck: I did my undergraduate work at NC State, completed my Ph.D. at the University of Illinois in Functional Analysis (Banach Lattices), and became a faculty member at Vassar College. I returned to Illinois after marrying N. Tenney Peck, a Mathematics professor at Illinois. During my 30 years on the faculty at Illinois, I was also Associate Dean of the College of Liberal Arts and Sciences. I made the decision to retire in 2002 and Dean Solomon recruited me to co-chair the capital campaign for PAMS. I am teaching one course per semester, working on fund-raising, and pursuing my lifelong interest in music.

Ethelbert Nwakuche Chukwu: Dr. Chukwu was mentioned as one of the first of the best of the group of "Great Black Mathematicians of the 1960's and 1970's" on the *Mathematicians of the African Diaspora* website created by Professor Scott Williams at the University at Buffalo, SUNY. Please visit www.math.buffalo.edu/mad/PEEPS/chukwu_ethelbert_nwakuche.html for Dr. Chukwu's bio.

Lavon Page: On Feb. 6 as part of the Gertrude M. Cox Award ceremonies Dr. Page was awarded a plaque citing *"Meritorious recognition for innovative excellence in teaching and learning with technology"*

Get Involved

The mathematics department invites all its undergrads to participate in various volunteer activities. These activities include:

- *Mentoring incoming freshman and transfer students*
- *Hosting Spend-a-day high school visitors that join you in your classes and lunch*
- *Participating in the Undergraduate Program Review Committee to help guide us in developing the math programs*
- *and other recruiting events.*

Please contact Jeff Scroggs or Bisa Meek if you are interested volunteering.
Undergrad@math.ncsu.edu

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