

ISMAA 2006 Abstracts

(Note: Student Abstracts are on a separate handout)

Friday, April 7

12:45-1:45p.m. *Proofs Without Words (and Words Without Proofs)* Plenary address, Roger B. Nelsen, Lewis and Clark College (Smith Hall)

Can pictures prove theorems? Rather than argue that they can or can't (words without proofs), I will present some pictures which may (proofs without words). In English, "to see" often means "to understand," and I think this is especially true in mathematics. To illustrate, we'll explore the role of visualization in mathematics to examine a little-known elementary but powerful idea (the Fubini principle) in a variety of settings, including combinatorics, infinite series, geometry and trigonometry, calculus, mathematical induction, and fast food.

2:00-2:50p.m.

Passing From the Discrete to the Continuous Using Modern Infinitesimals Nader Vakil, Western Illinois University (Science Center 204)

The discrete and the continuous are among the most fundamental categories of the human mind, and our urge for creating theories that connect the two has prompted us to invent and deploy the infinite sets. But the mathematics of the infinite done in the traditional way employs logic at levels of syntactical complexity that rarely occur in other areas of human discourse. This is the source of some of the pedagogical problems of classical analysis. Although this difficulty cannot be entirely circumvented, we can mitigate it with the methods of modern infinitesimals, which provide a new paradigm for the mathematics of the infinite. In this talk, we provide a brief exposition of these methods through examples of their applications in topology, functional analysis, and differential equations. This talk is intended to be accessible to graduate students; hopefully, to advanced undergraduate students as well.

2:00-2:25p.m.

MathZone Jennifer Huda, McGraw Hill (Smith Hall)

Interested in bringing technology into your courses? MathZone offers a simple solution to assign online homework, show individual student assessment, and stay in touch with students. Enjoy a presentation highlighting features including Video lectures, Online Homework, Test Generation, and ALEKS® technology integration.

GEOMETRY MEETS ALGEBRA: The Archimedean Solids Vince Matsko, Quincy University (Goldspohn 20)

Euler's formula may be used to prove algebraically that there are only five Platonic solids. Similar techniques may be used to enumerate the Archimedean solids. This enumeration is an intriguing interplay between algebra and three-dimensional geometry accessible to any student with solid algebra skills. (Note: This is not Kepler's enumeration as presented in Cromwell's *Polyhedra*.)

2:30-2:55p.m.

Addressing Key Math Teaching and Learning Issues with WileyPLUS Brad Franklin, Wiley (Smith Hall)

WileyPLUS (formerly eGrade Plus) gives you the technology to create an environment where students reach their full potential and experience academic success that will last them a lifetime! Instructor resources include a wealth of presentation and preparation tools, easy-to-navigate assignment and assessment tools, and a complete system to administer and manage your course exactly as you wish.

Projective Geometry via Geometric Algebras Rohan Attele, Chicago State University (Goldspohn 20)

Geometric algebras will be introduced and vector subspaces of \mathbb{R}^n will be interpreted as computable objects. In particular, the line through two points will be interpreted as an exterior product and the point of intersection of two lines will be interpreted as a regressive product. As an example of geometric algebras, Pappus and Desargue theorems from projective geometry will be interpreted as algebraic identities.

2:30-2:55p.m.

Visual LCM and GCD Roger B. Eggleton, Illinois State University (Goldspohn 22)

A concrete approach to natural numbers, in the spirit of Euclid, enables us visually to establish fundamental properties of the LCM and GCD of any two natural numbers a and b . While this talk will not quite be in the category of proof without words, it will definitely be in the spirit of such visual demonstrations. It will go as far as the important result that there are natural numbers m and n such that $|am - bn| = \text{GCD}(a, b)$.

3:15-3:40p.m.

Math Xpert Jerry Glynn, Mathware (Smith Hall)

Come see a demonstration of MathXpert, a window software program that shows the steps. MathXpert, for algebra through calculus, helps the student work through problems successfully. The easy-to-use interface allows students to concentrate on learning correct strategies of problem solving.

Math, Music, and Art: Insights into team teaching across disciplines Larry Van Oyen and Rich Wilders, North Central College (Science Center 204)

Larry Van Oyen (music) and Rich Wilders (math) team teach IDS 360: Math, Music and Art at North Central College. The course (based on Douglas Hofstadter's *Godel, Escher, and Bach*) explores the notion of formal systems in its three title disciplines. Mathematics uses axioms and the rules of logic to derive theorems, Escher's tessellations are constructed according to the rules of symmetry in the Euclidean plane, Bach's canons are likewise constructed in accordance with a set of formal rules. This talk will provide an overview of the course as well as discuss the process by which the course was created.

A New Proof of Brocard's Theorem on the Angle Bisectors Gregory Galperin, Eastern Illinois University (Goldspohn 20)

This talk presents a new and very elementary (but clever) proof that any three segments are the angle bisectors of a unique (up to congruence) triangle.

3:45-4:10p.m.

Eduspace and HM Assess Houghton Mifflin Technology Consultants (Smith Hall)

Eduspace is a web-based online learning system that provides instructors with powerful course management tools and text-specific content to support all of their online learning needs. By pairing the widely recognized tools of Blackboard with customizable content from Houghton Mifflin, *Eduspace* makes it easy for instructors to create all or part of a course online. Resources such as algorithmic and non-algorithmic homework, quizzes, tests, tutorials, instructional videos, interactive textbooks, live online tutoring with Smarthinking™, and additional study materials all come ready-to-use. *HM Assess* is a new diagnostic assessment tool from Houghton Mifflin.

The Birthday Problem: The Making of a Classic Dale K. Hathaway, Olivet Nazarene University (Science Center 204)

The Birthday problem is one of the best known coincidence problems in probability. I will discuss the history of the problem, how it became popular, and the impetus behind the development of its numerous variations and generalizations. Also included will be a discussion on who should get credit for its creation, which differs from the typical citation.

Certification and Endorsement Issues Todd Oberg, Illinois College and Mary McMahan, North Central College (Goldspohn 20)

This session will present information about changes and updates to earning a teaching certificate and endorsement in mathematics. There will be time for participants to ask questions and express concerns about issues related to teacher preparation in mathematics.

Post Banquet/Pizza Plenary Speaker: *Blown Away: What Knot to do When Sailing* Sir Randolph Bacon III (related to Colin Adams, Williams College) White Activities Center, 2nd Floor

Being a tale of adventure on the high seas involving great risk to the tale teller, and how an understanding of the mathematical theory of knots saved his bacon. No nautical or mathematical background assumed.

Saturday April 8

8:30-9:30a.m. *Connections Between Mathematics and Biology* Plenary Address, Carl Cowen, IUPUI-Indianapolis, MAA President (Smith Hall)

Carl Cowen will outline some of the research areas in the emerging collaborations between mathematical and biological scientists. In addition, Cowen, who began his study of the mathematics of neuroscience in 2002-03 at the Mathematical Biosciences Institute at Ohio State University, and who worked in 2003-04 as a junior post-doc in the lab of Prof. Christie Sahley in the Purdue University Biology Department, will illustrate the connection between mathematics and neuroscience with a discussion of the Pulfrich phenomenon, an experiment that helps illuminate how the brain processes visual images. There are few mathematical or biological prerequisites for this discussion.

9:40-10:05a.m.

What's the Academic Interview Process Really Like? An Informational Panel for Graduate Students
Panelists: Keven Hansen (Southwestern Illinois College), Patricia Kiihne (Illinois College), and Linda Sons (Northern Illinois University) (Smith Hall)

In this panel representatives from various types of institutions of higher education (Ph.D. granting institution, 4-year college, community college) will describe the hiring and interviewing processes at their schools and take questions. This presentation is aimed at graduate students but is open to all.

Group Writing Projects in Freshman Mathematics Courses Lanette Poteete-Young, Judson College (Science Center 204)

In this talk, I will share several years of experience in assigning group writing projects for two freshman classes: Calculus I and a Liberal Arts mathematics course for nonmajors. I will talk about what worked well and what didn't work as well and give lots of specific examples.

MODELING UNDER SELECTION BIAS Olcay Akman, Illinois State University (Goldspohn 20)

Field biologists often use on-site sampling to collect data, which are exposed to selection-bias. The probabilistic models that are assumed for population behavior are not entirely reflected in these sampling distributions. Selection-bias distorts the inherent probabilistic structure causing erroneous conclusions, called error of type III. We examine sampling under selection-bias and propose a modeling approach to recover parametric information about the assumed parent distribution.

Conditions for Convergence and Subsequential Convergence Mehmet Dik, Rockford College (Science Center 220)

Let (u_n) be a sequence, regularly generated by another sequence (α_n) where either (α_n) or $(\Delta\alpha_n) = (\alpha_n - \alpha_{n-1})$ is slowly oscillating. We investigate conditions under which the sequence (u_n) converges or converges subsequentially.

10:10-10:35a.m.

Panel: What Else Can You Do With a Math Major? Patrick McCray and Patricia Kiihne (Smith Hall)

Panelists with experience in mathematics outside of academia will describe opportunities in the business world for mathematics majors. The information presented should be useful not only to students planning future careers but also to faculty members advising undergraduate math majors.

Mathematics Teachers, Mathematics Teacher Educators, and Mathematicians in Illinois, 1857-1907
Nerida Ellerton & Ken Clements, Illinois State University (Science Center 204)

The year 1857 marked the opening of Illinois's first publicly supported university, Illinois State Normal University (ISNU), and for the next 50 years, all ISNU graduates studied arithmetic, algebra and geometry as part of their academic program. The 1850s and 1860s were pioneering years and ISNU had a profound effect on the teaching and learning of mathematics in schools in Illinois (and, indeed, in schools in other states as well). Documents illustrating the influence of ISNU on the common schools' curriculum and the teachers' approach to teaching will be presented. Following the opening of the Illinois University, and the University of Chicago, INSU's power base was challenged and ultimately eroded. With the establishment, in the 1890s, of a strong mathematics department at the University of Chicago – which quickly gained a

reputation of having one of the strongest mathematics departments in the nation – the emphasis began to change from “how to teach mathematics well” to “how to learn mathematics well.”

Role of Mathematics in Biomedicine Evans Afenya, Elmhurst College (Goldspohn 20)

Advances being made in the detection, treatment, and management of various diseases are discussed. The problems that still confront biomedicine today are highlighted. Following this, biomedical situations that demand the employment of mathematical approaches to overcoming difficulties encountered in clinical work are traced and identified. Consequently, mathematical models that capture and describe biomedical phenomena are introduced. The predictive properties of the models are used to propose ways in which the treatment of diseases could be approached with the aim of further demonstrating the significance and importance of mathematics in biomedicine.

The Onset of Superconductivity at Normal/Superconducting Interface Hala Jadallah, Western Illinois University (Science Center 220)

We study a modified model of Ginzburg and Landau that considers superconducting electrons leaking into a normal material in contact with a superconductor. We assume that each region occupies a half-space with a constant applied field parallel to the interface, we reduce the model to 1-dimension. We show, if the normal conductivity of the superconductor is less than the conductivity of the normal material then normal states are local minimizers for fields down to H_{c2} , which agrees with experimental observations that superconductivity is suppressed in this case. While when the conductivity of the superconductor is larger than that for the normal material the onset occurs at fields larger than H_{c2} and less than H_{c3} . Where the higher critical field H_{c3} is observed with the superconductor is in contact with vacuum.

10:50-11:15a.m.

Technology in Math Chris Christensen, Senior Technology Specialist, Addison Wesley/Benjamin Cummings (Smith Hall)

Today's students are more tech-savvy than ever before--they interact with multimedia on a daily basis. Addison-Wesley provides the most flexible, widely-used, math educational website in the world--MyMathLab. This website helps students learn the math & succeed. AW has also partnered with GTCO by offering the PRS Radio Frequency classroom response systems, providing another interactive avenue for instructors. Join us to learn more!

Knowledge Surveys: Helping Students Self-Assess Jon M. Clauss, Augustana College (Science Center 204)

With a shift in focus from teaching to learning, there is an obvious desire to increase the degree to which students are able to transfer the knowledge and skills acquired in one situation to new tasks or events. Recent developments in active learning theory point to the importance of helping students take control of their learning, monitor their level of understanding and assess learning strategies, in order to achieve this transfer. Knowledge surveys may be just the tool to improve a student's ability to self-assess and enhance the subsequent transfer of skills. Knowledge surveys cover the entire content of a course, as well as the full range of cognitive levels. Taken at the beginning, middle and end of the course, students rate their ability to answer questions about the course content. In addition to increasing the self-assessment skills of the students, the development of the survey also helps the instructor clarify course objectives, and design activities that test students' abilities at different cognitive levels.

Comparing Rubella Vaccination Strategies in China - Modeling and Simulation Linda Gao*, North Central College; Herbert Hethcote, The University of Iowa (Goldspohn 20)

Computer simulations of a deterministic model are used to predict the effect of the changing age distribution in China on the dynamics of rubella epidemiology and the incidence of congenital rubella syndrome (CRS). In comparing rubella vaccination strategies for China using simulations, our results predict some severe consequences of the current policy and suggest better alternatives for reducing and eliminating the incidence of CRS.

10:50-11:15a.m.

Asymptotic Problems for Dynamical Systems with Random-Walk-Type Perturbations Zhihui Yang, Western Illinois University (Science Center 220)

The asymptotic problems for dynamical systems with white-noise-type perturbations were considered in the classic work of Freidlin and Wentzell. My research work concerns a class of random perturbations which, in some sense, approximate white noise. For example, I considered random perturbations of random walks which converge to Wiener process. The Results concerning asymptotic behavior of dynamical systems with this random-walk-type perturbation was obtained under appropriate assumptions and compared with those with white-noise-type perturbations. An introduction of random perturbation of dynamical systems will be given in the talk as well as the result of my research work.

11:20-11:45a.m.

Tales of Oxen Eating Grass: A Famous Problem Posed by Isaac Newton that made its way into a School Arithmetic Textbook in the US in the 1830s Ken Clements & Nerida Ellerton, Illinois State University (Smith Hall)

In this session we will trace the history of a famous pasturage problem – originally formulated (we believe) by Sir Isaac Newton – which appeared in a U.S. school arithmetic text in 1834 and quickly became the source of much controversy within and between mathematicians and teachers of mathematics. The controversy lasted for at least 60 years. In the presentation we will state the problem, offer two quite different solutions to it, and then provide details of its fascinating history.

Updates on ISBE/NCATE Accreditation Issues Todd Oberg, Illinois College (Science Center 204)

This session will focus on changes that are relevant to mathematics departments regarding the state's move from NCATE 2000 standards to NCATE 2002 standards. Included will be comments pertaining to program reports and on-site visitations .

Computational Tools for a Two-Course Calculus Sequence for Biology Majors Timothy D. Comar Benedictine University (Goldspohn 20)

In an effort to better prepare research oriented biology majors for the increasing level of mathematical background needed for their future coursework and research, the Department of Mathematics at Benedictine University has begun to offer a rigorous two-semester calculus sequence for this audience. Two important course goals are the integration of mathematical and biological reasoning through the understanding of biological models and the development of skills to use appropriate computational software to analyze and solve biological problems. We discuss how and why we use Excel, Derive, Berkeley Madonna, and MATLAB to achieve these goals.

How To Get Started in Discovery-Based Learning Melvyn Jeter, Illinois Wesleyan University (Science Center 220)

For those who wish to try the method, what should they do to get started? How would they select their course materials? How would they present the materials? Compared to more traditional teaching techniques, how would they conduct their classes? How would the role between instructor and student change? What would be expected of the students? How would grades be determined? How do you modify the method to better fit your circumstances and students?

12:00-1:00p.m. *Gröbner Bases* Plenary Address, Polya Lecture by Bernd Sturmfels, UC-Berkeley (Smith Hall)

Gröbner bases provide a general purpose method for computing with polynomials in several unknowns. They can be seen to generalize three familiar mathematical algorithms: Gaussian elimination for solving linear equations, the Euclidean algorithm for finding the greatest common divisor, and the simplex method for linear programming. This lecture is an elementary introduction to Gröbner bases and their applications in algebraic geometry.