MAA Seaway Section Meeting

Spring 2009 at R•I•T

Abstracts

1. Ian Gatley, RIT, Friday night speaker

Math in a Wicked World

So called "Wicked Problems," for which traditional methods of solution are said to be inadequate, are increasingly being identified by experts in fields as diverse as business, warfare, public policy, program management, product design, and software engineering. In distinction to wicked problems, those problems readily amenable to solution by the methods and approaches of mathematics are said to be "tame." Where did this idea of "wicked problems" arise, and what is the role of math in this increasingly wicked world?

2. David Brown, Ithaca College

Experimentation in Mathematics and the First Year Student

About five years ago, I combined computer experimentation, writing, and discussion in a course intended for second semester mathematics students, and witnessed a surge is student understanding of the creative aspects of mathematics. Using open-ended problems and even some famous unsolved problems, such as the Collatz Conjecture, students are motivated to uncover mathematical ideas and to conjecture underlying principles. Students learn to use computer technology to generate and substantiate conjectures. In this talk, I give an introduction to experimental mathematics and how it is impacting mathematics in general and my teaching specifically. I discuss how this approach helped foster a deeper understanding of why we study mathematics and how mathematicians tackle ideas. Concrete examples show how student understanding improved during a semester full of writing. I also indicate how student attitudes toward mathematics changed over the course of the semester. Many students did not initially care for the open-ended approach, but ultimately came to value it.

3. Thomas Zaslavsky, SUNY Binghamton University

Eight Queens and More

The Eight Queens Problem asks for the number of ways to place 8 nonattacking queens on an 8×8 chessboard. The answer has been known (for more than a century) to be 92, but for n queens on an n×n board no general formula is known, nor is one likely to exist. Seth Chaiken, Chris Hanusa, and I have looked at generalizations with interesting enumerative properties. Here is one: Place q identical chess pieces on an nxn board, where q is fixed and n varies. The number $N_q(n)$ of nonattacking configurations is function of n. By applying a variant of Ehrhart's theory of counting 1/k-fractional points in a convex polytope we show that $N_q(n)$ is given by a cyclically repeating series of p polynomials of degree cq, where c is a constant determined by the chess piece, provided that the piece's moves are unlimited, like those of a queen, rook, or bishop but not a king or knight. We also estimate the value of p.

4. Harry M. Gehman Lecture: Steve Strogatz, Cornell University

The Calculus of Friendship

In this talk, Professor Strogatz tells the story of his ongoing friendship with his high school calculus teacher, Mr. Don Joffray, as chronicled through more than 30 years of letters between them. What makes their relationship unique is that it is based almost entirely on a shared love of calculus. For them, calculus is more than a branch of mathematics; it is a game they love playing together, a constant when all else is in flux. The teacher goes from the prime of his career to retirement, competes in whitewater kayaking at the international level, and loses a son. The student matures from high school math geek to Ivy League professor, suffers the sudden death of a parent, and blunders into a marriage destined to fail. Yet through it all they take refuge in the haven of calculus Š until a day comes when calculus is no longer enough. Like calculus itself, this lecture is an exploration of change. It's about the transformation that takes place in a student's heart, as he and his teacher reverse roles, as they age, as they are buffeted by life itself. It is intended for a general audience, and especially anyone whose life has been changed by a mentor. (It also includes some nifty calculus problems.)

Saturday Afternoon Speakers

1. Christopher Baltus, SUNY Oswego

Projective Geometry before Projective Geometry: The Case of Brianchon's Theorem, 1806

Poncelet's 1822 Treatise on Projective Figures may mark the separation of projective geometry from Euclidean geometry, but it was not the beginning of the subject. In following Brianchon's beautiful proof, 1806, of the theorem bearing his name, we can tour the subject as it stood before Poncelet, including crucial use of the pole/polar concept. [B's Thm: If a hexagon is circumscribed about a conic, then the diagonals on opposite vertices are concurrent.]

2. Daniel Birmajer, Nazareth College

Substantial sets

A polynomial with coefficients in a field can be thought both as a purely algebraic construction and as a evaluation function, by plugging-in scalar values for the variables.
This dual perspective on the polynomials allow us to ask the natural question: Is it true that two polynomials represent the same function if and only if they are the same polynomial?
It is an elementary observation that this question is in fact equivalent to ask: Is it true that a polynomial represents the zero function if and only if it is the zero polynomial?
In this talk we will continue to examine this question for polynomials in several variables over different fields, by introducing the concept of substantial sets.

3. Matthew Coppenbarger, RIT

Exploring solids whose parallel cross-sections are regular polygons

As an introductory exercise to calculating volumes by slicing, many calculus textbooks use these solids as an icebreaker to the traditional problems of calculating volumes of solids generating by rotating regions about one of the coordinate axes. In addition to plotting the aforementioned solids with Maple, we will explore their characteristics using basic integral calculus, multidimensional calculus (along with some matrix algebra), and a short excursion into real analysis.

4. Marvin Gruber, RIT

Tikhonov Regularization Ridge Regressions and Penalized Splines

Hoerl and Kennard are generally regarded as the inventors of ridge regression used by statisticians as a method of dealing with multicollinear data. However ridge regression is really the solution for finite dimensional spaces to an inverse problem about linear operators in Hilbert spaces that do not have continuous inverses proposed and solved by Tikhonov. The method of solving the linear operator problem called Tikhonov regularization is important to the solution of integral equations that arise in Physics and Engineering. The similarity of Tikhonov regularization and ridge regression will be explored. In addition an example of the application of ridge regression to spline models will be given.

5. James Halavin, RIT

Retention and the Relationship to First Year Mathematics Courses

Retention is an important concern of most colleges and universities. In a study of students taking first year mathematics courses we investigate the relationships between retention, the use of early alerts in courses, and the results of the Mathematics Placement Exam (taken by incoming freshmen).

6. Anthony Harkin, RIT

A Network Theory Approach to Hyperspectral Image Segmentation

Hyperspectral images are digital images, often taken either from an airplane or satellite, in which each pixel has not just the usual three visible bands of light (red at 650nm, green at 550nm, and blue at 450nm), but on the order of hundreds of wavelengths so that spectroscopy can be conducted on the materials on the ground. This extremely powerful remote sensing technology has proven useful in many domains, including crop identification, geological studies, homeland security, and detection of environmental waste. Although hyperspectral imaging is an emerging technology with enormous potential, it is currently hindered by the shortage of effective algorithms to analyze the resulting data sets, which consist of millions of points having a nonlinear distribution in 100+ dimensional space. The goal of image segmentation for a hyperspectral image is to devise an unsupervised algorithm that partitions the image by placing each pixel into one of several clusters, or spectral classes. The standard data analysis algorithms for spectral and multispectral imaging, which use linear methods and multivariate statistics, break down on complex scenes and are unable to extract information from the nonlinear structures embedded in the data. In this talk, we describe how HSI data can be analyzed by imposing a network structure on it. The problem of image segmentation then maps to the problem of detecting community structure on networks.

7. Jonathan Hoyle, Eastman Kodak

Introduction to Surreal Numbers

Surreal numbers are a superset of the real number line, including infinite and infinitesimal values. Although it shares many properties of other extensions of the reals, it has a number of unique and very powerful features, including being the "largest" possible extension of R. The purpose of this talk is to give a brief overview of the surreals, and demonstrate how Calculus would look in this intriguing number system.

8. Chulmin Kim, RIT

A note on Some Structured Antedependence Models for Longitudinal Data

The goal of covariance modeling, like that the mean modeling, is to obtain as parsimonious a presentation of the covariance as possible, yet one that fits the data well. The variance-correlation parameterization, in which parsimonious models are specified for the variances and the correlations and the precision matrix specification, in which parsimonious models are specified for the elements of the inverse of the covariance matrix are commonly used covariance modeling. Antedependence (AD) models can be useful for covariance structure for longitudinal data. AD models are generalization of Autoregressive (AR) models that allow the variances and same-lag correlations to vary over time. Zimmerman introduced a structured AD model which may be more useful than an unstructured AD model for some non-stationary longitudinal data. An example is given in which a structured AD is more useful than a stationary AR and an unstructured AD. And we generalize the univariate AD model to multivariate AD model, MAD and study its properties and illustrate the properties of MAD to use an example.

9. Min Chung, Hartwick College

Perturbations of the Haar wavelet

The Haar wavelet is a piecewise continuous function with jump discontinuities at 0, 1/2, and 1. By using the convolution of Haar wavelet and an appropriate integrable function, Aimer, Bernardis, and Gorosito provided a perturbation of Haar wavelet which becomes a Riesz basis. Since such convolution always provides a continuous function, especially at 0, 1/2, and 1, it is an interesting question that whether it is possible to obtain a perturbation of Haar that is continuous at 0, 1/2, or 1, but doesn't need to be continuous at all of them. We will provide an explicit way of constructing various perturbations of Haar wavelet which could be partially continuous. In this way, we also provide an alternate way of generating the Riesz basis of Aimer et al but with better frame bounds

10. Erika King, Hobart and William Smith Colleges

Dominating Triangulated Graphs

A *dominating set* in a graph G is a set of vertices of G such that each vertex in G is either in the set or adjacent to a vertex in the set. The *domination number* of a graph G is the minimum cardinality of such a set in G. In 1996, Matheson and Tarjan proved the domination number of an n-vertex triangulated disc is at most $n/3$. They then conjectured that any n-vertex triangulation with *n* sufficiently large has a dominating set of size at most *n*/4. We will discuss their proof and show that we can prove their conjecture for graphs of maximum degree 6. This is joint work with Michael J. Pelsmajer.

11. Larry Knop, Hamilton College

Google's PageRank, the Simple Version

Type some words into Google's search bar, press enter, and in milliseconds you have an *ordered* list of search results. Google's search results are ordered by the PageRanks of the websites that contain the search terms, and PageRank, in its simplest form, is elementary linear algebra. Simple PageRank is just the eigenvector associated with the dominant eigenvalue of a Markov matrix. The presentation will define simple PageRank, illustrate some of its virtues and some of its vices, and conclude with a modification of PageRank that addresses one major problem.

12. Patti Frazer Lock, St. Lawrence University

Learning Concepts in Calculus: Some Interesting New Results

A new study provides some compelling evidence that active, engaged learning is significantly better than lecturing at helping students learn calculus. The study also provides strong evidence that all of us can learn to be effective and interactive calculus instructors. The Calculus Concept Inventory is used to test gains in understanding in Calculus I, with the most recent and most impressive results coming from the University of Michigan. We will describe the study and discuss the implications (in an interactive style!) with the audience.

13. Manuel Lopez, RIT

In search of a general notion of pseudoinverse

The traditional approach to the pseudoinverse in our linear algebra courses starts with a matrix whose columns are linearly independent and prescribes a recipe to compute the pseudoinverse. We look at two objections to this approach. First, why must the columns be linearly independent? Also, for this concept not to be an ad-hoc construction what should be the properties that single it out from a category theory point of view? How do the Penrose conditions fit in?

14. Carl Lutzer, RIT

The Alpha and the Omega of 1st Year Calculus

Most students complete their first year of calculus with Taylor Series. In this talk, I'll present a simple way to---crazy as it sounds---begin the year with Taylor expansions. I'll discuss the immediate payoff in the study of differential calculus, and touch on some of the long-term benefits that arise in integration theory and beyond.

15. John Maceli, Ithaca College

Fairness and the Problem of Points

This talk will give a brief historical development of the famous "Problem of Points." We will discuss a number of ways to solve this problem including solutions developed by Pascal and Fermat. Finally a surprising connection to an estate division problem arising in the Talmud will be given.

16. James Marengo, RIT

Bugs Chasing Bugs

Let n be a fixed positive integer which is at least three and suppose n bugs are positioned at the vertices of a regular n-gon . Label the vertices V1, V2,...,Vn in counterclockwise order, with bug i located at Vi. At a certain instant (t=0), the bugs start moving, with bug i chasing bug i+1(for i=1,2,...,n-1) and bug n chasing bug 1. We assume that, at any instant, each bug is moving at the same speed, although this speed may not be constant. At the instant when the bugs meet at the center of the polygon, how far has each bug traveled? This problem appears in many calculus textbooks for the case n=4. The author will present a solution for general n and then discuss the possibility of solving this problem without calculus.

17. Tony Mastroberardino, Penn State Erie, the Behrend College

Three-dimensional equilibrium crystal shapes with corner energy regularization

The evolution equations of crystal growth often employ a regularization of the surface energy based on a corner energy term. Here we consider the effect of this regularization on the equilibrium shape of a solid particle in three dimensions. We determine that a sufficient regularization involves only one of the two isotropic invariants related to curvature. Using a long-wave approximation, we derive a nonlinear equation for the shape of a semi-infinite wedge in the case when the surface energy has cubic symmetry. An analytic description of the solution along an edge is given as well as an exact solution for a special case of anisotropy. Finally, this equation is solved numerically to demonstrate explicit solutions for which the regularization rounds the edges of the unregularized crystal shape.

18. Yozo Mikata, Bechtel

CNT Self-Folding Problems in Two Geometrical Configurations

This talk will examine the self-folding of carbon nanotubes (CNT) in two different geometrical configurations. In each configuration, an approximate solution is obtained for a critical threshold length for the self-folding of the carbon nanotube. In constructing the approximate solutions, the exact solution to Euler's elastica problem is utilized, which involves elliptic functions and elliptic integrals. The comparison results will indicate which geometrical configuration is likely to happen in nature.

19. Darren A. Narayan, RIT

Real World Graph Theory

We will give an overview of the NSF-CCLI Project, STEM Real World Applications Modules, which seeks to enhance student learning by motivating mathematical concepts with cutting-edge applications. Technological applications which will be discussed in this talk include analyses of fiber-optic telecommunications networks (National LambdaRail); 3-D surface reconstruction (Microsoft Research); and airline flight routes (JetBlue Airways).

20. Joshua Palmatier, SUNY Oneonta

Presenting Factoring Trinomials

Most textbooks and instructors present the factoring of trinomials using the "guess and check" method, which is not incredibly intuitive for most students. What we would like is a way to connect the factoring of a trinomial to the opposite operation of multiplying two linear binomials. In essence, factoring the trinomial is the reverse of FOILing two binomials. But how can we teach it in such as way that the students see that? In this talk, the factoring of a trinomial will be presented to the students in such a way that they can visually "see" the unFOILing process in action, which will help them understand how the two processes connect to each other.

21. Gabriel Prajitura, SUNY Brockport

Statistical convergence

We will discuss a notion connecting sequences, matrices, functions and the distributions of the prime numbers.

22. Likin C. Simon-Romero, RIT

Size Levels and Hyperspace Graph of Connected Subgraphs

Other - Given a connected graph G with N edges and a positive integer $n < N+1$, we define the nth-size level graph $Q_n(G)$ such that every vertex of $Q_n(G)$ represents a connected subgraph of G with n edges. Similarly, the Hyperspace Graph of Connected Subgraphs C(G) is the graph such that every vertex represents a connected subgraph of G with a special adjacency relation. In this talk we will give a detailed explanation of the two definitions and present some results concerning such graphs.

23. Paul Seeburger, MCC

Dynamic Visualization Tools for Multivariable Calculus

A tour of an NSF-funded project that seeks to develop geometric intuition in students of multivariable calculus. This online exploration environment allows students (or instructors) to create and freely rotate graphs of functions of two variables, contour plots, vectors, space curves generated by vector-valued functions, regions of integration, vector fields, etc. A series of assessment/exploration activities have been designed to help students "play" with the 3D concepts themselves, and to assess improvements in geometric understanding gained from the activity. The results of the first semester of this assessment will be shared. If time allows, other concepts from multivariable calculus, including directional derivatives, gradient vectors, and tangent planes will also be demonstrated.

24. Gary Towsley, SUNY Geneseo

Signore Galileo, Are You Joking?

In his major work on Astronomy, Galileo Galilei presented a conjecture on the actual path of an object falling to the center of the Earth. His guess was both remarkable and wrong. The fact that it was incorrect was immediately pointed out to him by other Mathematicians, including Pierre de Fermat. To this criticism Galileo gave an interesting reply, namely that he was kidding. Was he kidding?

25.Yolande Tra, RIT

Structural Equation modeling for categorical variables

Structural Equation modeling (SEM) is a comprehensive statistical approach to test and confirm specified hypotheses about relations among measured and latent variables. One of the assumptions of the model is multivariate normality that cannot be satisfied for categorical variables. We will explore the complexity of its implementation for binary/ordinal observed variables, including polychoric correlation, handling missing values, non-positive definite covariance matrix and checking model validity. We will illustrate the method applied to student financial awareness aptitude.