Heather Akerson
College of Saint Benedict, MN Delta
RNA Secondary Structure Statistics

In 2004, Robert Willenbring described a new statistic on RNA secondary structures called the B statistic. Biologists have suggested that this statistic might be used to discriminate among different types of RNA. In this talk, I will report my findings.

Meghann Barger
Western Oregon University, OR Delta
Relatively Prime Polynomials

We will be exploring the probability of relatively prime polynomials where the coefficients are elements of finite fields. We will explore the greatest common divisor of polynomials in $\mathbb{Z}_2[x]$ and $\mathbb{Z}_5[x]$. Then we will generalize this to consider polynomials with coefficients from a general finite field.

Samuel Behrend
Denison University, OH Iota
A Math Classic: The Tale of Three Links

Recently, there has been considerable work dealing with the linking properties of graphs, spurred by Conway and Gordon's seminal result regarding K_6. However there is no method of determining n-links in straight-edge embeddings. We explore triple links in straight-edge embeddings of K_9. This presentation is intended for a general audience.

Alicia Brinkman
Saint Norbert College, WI Delta
Construction of Square Wheel Bicycle

In this talk we will discuss the history of the square wheel bicycle and develop a differential equation that describes the road required for the smooth motion of the wheel. The resulting solution for the road is given by a catenary curve. As part of the Math Modeling course at St. Norbert College, twelve students collectively built a square wheel bicycle and the required road. The result is that it works.

Ashley Burt
Pepperdine University, CA Xi
Linear Fixed Point Theory

We consider an interesting new problem, which can be viewed both as a linear algebra problem and a fixed point problem: $x = (N * (N * x)^{(-1)})^{(-1)}$, where $x^{(-1)}$ is the entry-wise inverse (the reciprocal of each entry), given matrix N and its transpose N'. In this talk we discuss some of the basic ideas and theoretical results we have developed so far.

Shawn Case
Fitchburg State College, MA Eta
Dynamical Systems: Sink or Source

I will discuss how to analyze a standard capacitor-resistor circuit problem using dynamical systems. I will show other applications of differential equations. When analyzing a linear dynamical system, the eigenvalues and eigenvectors of the matrix play an important role. I will take the time to point out the many different relations.

Kristin Creech
University of Texas at Arlington, TX Iota
Dual Dilation of Two-Interval Wavlet Sets

I will present results regarding dual dilation two-interval wavelet sets on $\mathbb{R}$. We will review known results involving dilation by two on the left and right sides of zero. We will fix one dilation factor while we allow the other to vary as well as allowing both to vary.

Erica Cross
Youngstown State University, OH Xi
Regression Statistics: Type II Censoring

Suppose a bivariate normal random sample of size n is subjected to Type II censoring on one of the variates so that only a set of p order statistics and their concomitants are observed. We will obtain approximations to the distributions for the correlation of these statistics. Simulation, method of maximum likelihood, and moment matching techniques will be used to express parameters. We will examine the goodness-of-fit of these approximations.

Jennifer Crounse
Fitchburg State College, MA Eta
Pascal's Triangle in Secondary Education

There are countless applications in which Pascal's Triangle cam be used to solve everyday mathematical problems. My presentation will focus on specific statistic and algebraic applications that can be integrated into secondary education. I will apply Pascal's Triangle to statistics by exploring probability of specific outcomes of independent events and determining binomial distribution coefficients. I will also demonstrate how to find the coefficients for binomial expansion problems in algebra.

Abdulmajed Dakkak
University of Toledo, OH Gamma
Erdös-Faber-Lovasz Conjecture

The Erdös-Faber-Lovasz conjecture states that a linear hypergraph with n edges each of size n is n-chromatic. It has recently been shown that $n + o(n)$ is an upperbound. We approach the problem using the computer and revisit a 1981 paper by Neil Hindman to show the conjecture is true for $n < 20$.

Tyler Drombosky
Youngstown State University, OH Xi
Hodgkin-Huxley Model

Mathematical modeling plays an important role in the advancement and understanding of the exceedingly complex activity patterns in the brain. Much of this work is based on Hodgkin-Huxley model (1952), a system of differential equations modeling the electrical activity in a single neuron. This talk will introduce and motivate the model and then use it to explain characteristics of real neurons by presenting several numerical experiments that display various neuronal activity patterns.

Krista Foster
Youngstown State University, OH Xi
Thermal Nondestructive Evaluation

Aero and space structures are composed of modern composite materials containing significant porosity. Based on research done at North Carolina State University, I will discuss a computational model developed for NASA to test for damage in these materials. Using the heat equation, a nondestructive procedure for thermal interrogation is modeled. The structure is subjected to flash heating, and temperature along the boundary is observed. From this data, we attempt to determine any possible internal damage to the material.

Iordan Ganev
Miami University, OH Delta
Order Dimension of Subgroups

The number of different orders of nonidentity elements in a group is limited by the number divisors of the order of the group. This upper bound can be made more specific for proper subgroups, and can be calculated from the prime power factorization of the group's order. Some groups have subgroups with the highest possible number of different orders for nonidentity elements. This property can be characterized and general results exist for several families of groups.

Yair Goldberg
The University of North Carolina at Greensboro, NC Epsilon
Calculating Zeros of Zeta Derivatives

Considering how much is known about the zeros of the Riemann Zeta Function, it is surprising how little is know about the zeros of its derivatives. We will discuss some methods that can be used to approximate the zeros of these functions.

Brent Hancock
Pepperdine University, CA Xi
Linear Fixed Point: Results and Issues

We consider an interesting new problem, which can be viewed both as a linear algebra problem and a fixed point problem: $x = (N' * (N * x)^{(-1)})^{(-1)}$, where $x^{(-1)}$ is the entry-wise inverse (the reciprocal of each entry), given matrix N and its transpose N'. In this talk we discuss additional results for certain types of matrices N and some of the numerical issues that have arisen in solving this problem.

Damon Haught
Youngstown State University, OH Xi
An Introduction to Degree Theory in $\mathbb{R}^n$

This talk will present results from my senior research project and will include an introduction to Degree Theory in $\mathbb{R}^n$ as well as applications.

Lisa Hickok
University of Illinois at Urbana-Champaign, IL Alpha
Pascal's Hexagons

Placing 1's on the upper three sides of a hexagon in an integral lattice and applying Pascal's algorithm produces a finite hexagonal array. We developed closed formulas for the last row and devised pedagogical and visual generalizations. We also search for patterns and recursions in this construction.

John Hoffman
Youngstown State University, OH Xi
Symmetries of Polynomials

We will explore some facts about symmetries of polynomials. One question is whether a polynomial can have a slant line as a line of symmetry. Also, we will investigate whether a polynomial can have more than one line or point of symmetry.

Adam Hughes
University of Illinois at Urbana-Champaign, IL Alpha
Classification of Symmetric 2-Cocycles

We present a classification of the "additive, symmetric 2-cocycles" of arbitrary degree and dimension, expanding greatly on results from both Lazard and Ando, Hopkins, and Strickland. The ring classifying these polynomials finds widespread application in many areas, including algebraic topology–particularly elliptic cohomology and formal group laws.

Sara Jensen
Carthage College, WI Epsilon
Proving the Anti-Pasch Conjecture

The anti-Pasch conjecture was proposed by Paul Erds in 1976. The conjecture involves constructing Steiner Triple Systems with desirable properties. Although the conjecture was proven in 2001, this talk will introduce Steiner Triple Systems and give a combinatorial proof of the anti-Pasch conjecture.

Bill Kay
The University of South Carolina, SC Alpha
Seymour Second Neighborhood Conjecture

Seymours Second Neighborhood Conjecture is as follows: "Let $G = (V, E)$ be a directed graph. Then there exists a vertex v which has the property that the number of vertices at distance 2 is greater than or equal to the vertices at distance 1". We suppose the existence of a counterexample and explore necessary girth, directed cycles, minimum degree, and other extremal properties of such a graph.

Brendan Kelly
The College of New Jersey, NJ Theta
Zero-Divisor Graphs

The zero-divisor graph of a commutative ring with unity is given by a vertex set which contains all non-zero zero divisors and an edge set which contains (a, b) if $ab = 0$. This graph displays information about the multiplicative structure of the zero divisors. The talk will establish ways of finding out algebraic information by looking at graphical properties of the zero-divisor graph.

Kevin Kreighbaum
Mount Union College, OH Omicron
Can You Spare a Square?

Catalan numbers are a sequence of natural numbers found in various counting problems. The sequence begins: 1, 1, 2, 5, 14, 42... and can be defined recursively. Find out how to derive these numbers by simply entering a bathroom stall.

Arielle Leitner
California State University, Chico, CA Omicron
Universal Cycles of Classes of Sequences

A connected digraph in which the in-degree of any vertex equals its out-degree is Eulerian; this fundamental and elementary result is used as the basis of existence proofs for universal cycles (also known as deBruijn cycles or U-cycles) of several combinatorial objects. We present new results on the existence of universal cycles of certain classes of functions, following work of Bechel and LaBounty-Lay who studied onto functions and 1-inequitable sequences on a binary alphabet. In each case the connectedness of the graph is the non-trivial aspect to be established.

Daniel Lithio
Hope College, MI Delta
Optimizing a Volleyball Serve

An effective volleyball serve will drop to the ground both quickly and close to the net. We model the forces due to gravity, air resistance, and the spin of the ball, with differential equations and find coefficients experimentally. We then use the model to find optimal serving strategies.

W. Ryan Livingston
Youngstown State University, OH Xi
Can 2008 be the First Digits of 2^n?

This talk will address this problem specifically and in a more general case. Some consequences of results will also be presented.

Jim Manning
The University of South Carolina, SC Alpha
Piles of Tiles

By considering tilings of simple rectangular regions and implications of the Spanning Theorem, we can quickly extend the notion to larger regions. This gives rise to the concept of complexity (determined by rectangular groupings of tiles which exhaust the region), thereby allowing interesting extensions to regions with non-integer side lengths.

Vincent Martinez
The College of New Jersey, NJ Theta
Plant-Pathogens Dynamics

The goal of this paper is to show how a certain plant population interacting with a harmful pathogen can be modeled as a reaction-diffusion phenomenon. Though the foundations of the model are based on well-known laws, the novelty in our approach lies in the assumption made about the diffusion terms.

Cheyne Miller
Iona College, NY Psi
Group Structure on Polytopes via Connected Sum

Vector operations on h-vectors that come from combinatorial structures such as polytopes, produce vectors that can not be realized as the h-vector of a simple convex polytope. Through low dimensional examples, it is clear how the Dehn-Sommerville relations prevent one from putting a group structure on the set of h-vectors associated to certain families of polytopes. The focus will be the algebraic structure of these h-vectors in conjunction with the connected-sum operation. Moreover, a detailed example of the connected-sum operation will be given, as this operation is relatively new and explicit examples are not easily found.

Kathleen Miller
Saint Norbert College, WI Delta
Genetic Modeling of the White Buffalo

In August 1994, a female white buffalo was born in Wisconsin. In this talk, we discuss a mathematical model for predicting the frequency of such an event. The model is built around the theory of genetics, including mutations and albinism. We then attempt to answer: when will it happen again?

Daniel Monfre
Carthage College, WI Epsilon
Fibonacci and Base-2 Psuedoprimes

Two tests for determining whether a number is prime are the Fibonacci and the Fermat base-2 tests. Although each test is imperfect in itself, there is no known integer for which both tests give the wrong answer. We shall discuss some results of a search for such an integer.

David Nassar
University of Akron, OH Nu
Mathematical Model of Biofilm Growth

A biofilm is a community of microorganisms embedded in a matrix of polysaccharides, proteins and nucleic acids. Treatment of infections caused by biofilms is complicated because microorganisms growing in biofilm conditions are highly resistant to antimicrobial agents. This presentation describes a mathematical model addressing the treatment of biofilms.

Peter Olszewski
Fairfield University, CT Gamma
Group Presentations and Cayley Graphs

The purpose of this paper is to examine the relationship between groups, group presentations, their Cayley graphs, and associated Markov Processes. In particular, we prove that for a finite group derived from an ergodic Markov Process, a process we describe in this paper, the long range equilibrium vector is uniform on the group elements, as to be expected. We also prove a theorem giving a complete characterization of finitely generated free groups in terms of their associated Markov Processes.

Ryan Pavlik
Saint Norbert College, WI Delta
Sudoku for the Algorithmically-Minded

Whether or not you know about the popular Sudoku logic puzzles, you can enjoy this discussion of basic Sudoku strategy. Given the technically-minded audience, we will explore the basic strategies to solve a Sudoku without guessing, and reflect on the algorithmic techniques we are using and learning as we go.

Jared Ruiz
Youngstown State University, OH Xi
A Surprising Sum of Arctangents

By using not well-known and oftentimes incorrect trigonometric identities, we will prove that for every positive integer n, there exists a positive integer s and distinct positive integers k_i such that $\sum_{i=1}^{s} t_i \arctan k_i = n\pi$ where $t_i \in \{-1, 1\}$.

Diana Saly
University of New Hampshire, NH Alpha
Stability Tracking of Treadmill Running

This paper develops a method to identify and illustrate a runner's unique footprint. Using the Qualysis motion capture system, The Timberland Co. collected data from ten different runners in eight different areas. This data was analyzed using Singular Value Decomposition to simplify the data without losing any information. We found that our data was linearly dependent and three-dimensional. Plotting the three principal components from the augmented SVD matrix, we were able to find a unique patter for each runner which we call the runner's footprint. We then broke down the individual strides creating the runner's footprint to determine stability and efficiency of the runner.

Stephanie Schauer
Saint Norbert College, WI Delta
Rolling Smoothly on a Saw-Tooth Road

Given a road constructed from a periodic pattern of isosceles triangles, how does one build a wheel that will traverse the road smoothly? Through a change of variables to polar coordinates, a "messy" problem reveals itself as a simple spiral. In this talk, we discuss the details behind the solution and discuss some interesting discoveries.

Douglas Smith
Miami University, OH Delta
Finding Tows of Pascal's Triangle mod 3

We discuss the structure of Pascals Triangle modulo 3 and demonstrate based on the basic recurrence relationship in Pascals Triangle that sub-triangles have an additive structure entry-wise. Using mathematical induction we then determine the entries of any given row of Pascals Triangle modulo 3.

Nathan St. John
Miami University, OH Delta
Bounds on the Davenport Constant

Of interest in combinatorics are minimal zero-sequences, those which do not contain a proper zero-subsequence. There are beautiful results associated with their study, most of which concern the Davenport constant. Various bounds for a variant of the Davenport constant are given, as well as an original lower bound.

Shira Stav
University of North Carolina at Charlotte, NC Theta
Poisson's PDE

We developed analytical solutions using separation of variables for the 2D Poisson equation over a rectangular domain for all combinations of (non)homogeneous Dirichlet, Neumann, and Robin boundary conditions, including Robin-Robin. This was implemented in Matlab with both analytical output of the solutions in LaTeX, and a variety of contour plots.

Samuel Taylor
The College of New Jersey, NJ Theta
Tangent and Normal Vectors to Investigate Knots

By examining the curves on a sphere associated with tangent, normal, and binormal vectors of a given knot, we can better understand certain properties of the knot. With these tools, important invariants like crossing number and bridge index can be better understood. We will discuss how these vectors help us to investigate the properties of knots and then provide some results that follow.

Kristal Temple
Western Oregon University, OR Delta
What I Did With My Summer

We shall present interesting mathematics results based on experiences at the 2008 Summer Mathematics Program for Undergraduate Women at Carleton College in Minnesota.

Jeremy Thompson
United States Air Force Academy, CO Gamma
Numerical Semigroups and Wilf's Conjecture

We will discuss the algebraic structure known as a numerical semigroup and basic definitions related to them. We will examine Wilf's conjecture and an approach to a possible solution using intersections of symmetric semigroups.

Seena Vali
Fordham University, NY Alpha Nu
Ordering of Sparse Matrices of GF(2)

A sparse matrix is made up of mostly zero-entries. They can be inverted or factored into the LUP factorization in the same way as a normal matrix, but there are also special factorization methods which are much faster and more efficient. For example, normally a matrix would be LUP-factored using Gaussian Elimination, but a sparse matrix would quickly become non-sparse with this method. However, a relatively simple reordering of columns and rows of the matrix can postpone this phenomenon and provide a substantial increase in the speed of factorization. In 1972, D.J. Rose published the MinDegree algorithm, enhanced by many later authors, and described by T. Davis in his book Direct Methods for Sparse Linear Systems, who also implemented the algorithm for MatLab. The MinDegree algorithm operates by manipulating the graph whose adjacency matrix is the matrix being Cholesky factored. However, the algorithm works over the real numbers, and problems arise in cryptography and other fields that work over GF(2). We found that by making a few slight, but crucial changes in the process of degree ordering the matrix, we can arrange the matrix such that the factorization is more efficient and quicker. Using the property that if r and s are nonzero in GF(2), then r + s is zero, we adjust the ordering algorithm which greatly increases the speed of factorization of the sparse matrix. As it turns out, this translates to changing a "logical OR" in deciding which edges to create/destroy in the MinDegree graph to an "exclusive OR."

Corey Vorland
Saint Norbert College, WI Delta
Modeling Diatom Growth in Trout Lake

Aulacoseira is a freshwater diatom whose abundance and colony size has been measured at varying depths in Trout Lake in Northern Wisconsin. Its population growth patterns are influenced by temperature, light availability, and nutrients. In this talk, the vertical distribution of Aulacoseira is investigated through modeling, which incorporates natural characteristics of the lake as well as effects of the diatom's buoyancy. Predicted outcomes are compared to measured observations. This work is joint with Stephanie Schauer, an undergraduate student also at St. Norbert College.

Doug Wajda
Youngstown State University, OH Xi
Modeling Traffic Flow

This talk will discuss the use of partial differential equations and the method of characteristics to model a traffic flow. The car density profile will be explored as a function of time and crash avoidance discussed. The behavior and accuracy of the model will be examined along the characteristic curves.

Allison Wiland
Youngstown State University, OH Xi
Fibonacci Numbers in Architecture

Fibonacci numbers are related to the golden ratio, which is widely used in architecture. We will explore many connections between these unique numbers and the designs of buildings.

Moriah Wright
Youngstown State University, OH Xi
The Cauchy Condensation Test

The Cauchy Condensation Test is an extremely interesting test used to determine the convergence and divergence of infinite series. We will explore a proof and examples using the test as well as examine the expansion for the general theorem.