The Eleventh Annual Nebraska Conference for Undergraduate Women in Mathematics

January 30–February 1, 2009

TALK ABSTRACTS

PLENARY TALKS

Sun-Yung Alice Chang, Princeton University
How Can You Tell If It Is a Sphere?

One question which fascinates mathematicians is when can we tell if a surface is a sphere– it turns out this question can be answered by a "uniformization theorem" which classifies all (2-dimensional) surfaces. In this talk, I will discuss this theorem and some efforts by mathematicians to generalize this result to higher dimensional spaces.

Mary Lou Zeeman, Bowdoin College
Feedback Loops in Biology and Climate

One of the most powerful features of mathematics is that it can unify ideas from a wide variety of disciplines. Understanding this allows us to harness math to dive deeper into scientific mysteries. For example, we will look at how feedback loops lead to cyclic behavior in population dynamics, our hormones and our global climate.

Talks by Undergraduate Students

Karina Aliaga, New Jersey Institute of Technology

Does the Pyloric Neuron Exhibit Resonance

Many experiments have been performed on the crab Cancer Borealis with regards to determining the existence of resonance in neurons found in the STG. Membrane resonance is a property that many neurons exhibit where there is high impedance at a preferred frequency. If membrane resonance exists, then the neuron is capable of differentiating its inputs thereby been able to recognize an oscillatory input at a preferred frequency where the largest response will be produced. By conducting many experiments and creating a Hodgkin-Huxley model to the pyloric neuron, we can determine the existence of resonance in the cell.

Sarah Bailey, University of Nebraska-Lincoln
Heather Buss, University of Nebraska-Lincoln
Allison Mettler, University of Nebraska-Lincoln
Caitlin Spilinek, University of Nebraska-Lincoln

Effects of Plant Biomass, Plant Cover, and Added Nutrients on Orthoptera Abundance Across a Small Grassland Area: A Mathematical Modeling Approach

The Nutrient Network is a global and collaborative research project that is investigating the effects of resources and consumption on ecosystem processes. As a part of this ongoing project, we conducted field research at the University of Nebraska Lincoln's Cedar Point Biological Station over the summer of 2008. Our aim is to gain a better understanding of the community level interactions between nutrients, plant biomass, and plant species richness and their impact on grasshopper (Orthoptera) abundance and distribution across a small mixed-grass prairie ecosystem. A unique mathematical modeling approach is used as a part of the data analysis.

Brittany Baker, Saint Michael's College

Detecting Forged Signatures Using Wavelet Decomposition

An effective procedure for distinguishing between genuine and forged signatures is analyzing them with wavelets. This is best done by taking a level-one Harr wavelet decomposition, then calculating row and column sums using horizontal, vertical, and diagonal details for individual signatures. Matlab is then used to compare the sums of each signature to the sum of the average genuine signature. Signatures with sums relatively close to the average genuine signature are then considered authentic. Note: This research was done collaboratively with other participants in the Texas A&M pre-REU program during the summer of 2008.

Sarah Behrens, Coe College

Cram on Triangular Boards

This talk will introduce the game of Cram and then tie in some findings from my research. The most basic version of Cram is two players taking turns removing two adjacent spaces on an $n \times m$ board. The winner is the last player that is able to make a move. Traditionally the spaces are square and the boards are rectangular, so we investigated what happens when the spaces and boards are triangular.

Christine Bittner, Johns Hopkins University

Rotational Flow of Non-Newtonian Fluids: a Viscoelastic Model

We studied the rimming flow of a viscoelastic film on the inner surface of a hollow horizontal rotating cylinder. Assuming that the Reynolds number is small and the liquid film on the wall of the cylinder is thin, the simple lubrication theory is applied. For the steady-state flow of the Convected Maxwell fluid the mathematical model reduces to a nonlinear ordinary differential equation regarding the film thickness. We show that the liquid viscoelasticity changes the flow structure. In particular, the singularity, which was observed for pure viscous liquids within the same lubrication approximation, can be eliminated due to liquid elasticity. It is also shown that the elastic feature of the fluid leads to the non-symmetric shape of the polymeric film. For the viscoelastic fluids that can be characterized by higher Deborah numbers, the region with maximal thickness of the film shifts down to the bottom of the horizontal cylinder. This non-symmetric distribution results in a longer period of stabilization of the flow to the steady state regime. We performed a detailed numeric analysis of the model and revealed some critical regimes which are specific only for viscoelastic liquids. Using the method of perturbations, the approximate analytical solution of the governing equation is also found.

Ana Burgers, Nebraska Wesleyan University
Laurie de Castro, Gettysburg College
Kati McConville, Westminster College
Katy Nowak, State University of New York at Geneseo

Break it Down: Using Wavelets to Analyze Handwritten Letters

212 billion pieces of mail are processed by our postal system annually. The post office uses machines to decrease the time and man power required to sort the mail. We explored the techniques used by these machines to recognize the addresses. The goal of our project was to construct an algorithm using wavelets to distinguish different handwriting samples.

Heather Buss
see Sarah Bailey

Cameron Byrum, University of Mississippi

Robustness and Efficiency of the Theil-Sen Estimator in Simple and Multiple Regressions

We took a look at two regression methods, namely, the least squares method and the Theil-Sen estimator. The least squares method is the most commonly used estimator, but it is known to lack efficiency with non-normally distributed error terms and to lack robustness to outliers. The Theil-Sen estimator is based around the median and is consequently far more robust to outliers. We take a look at both estimators in simple linear regressions and in multivariate models to compare the robustness and efficiency of each.

Elena Caffarelli, Canisius College

Constructing Real and Hyperreal Numbers

Dedekind and Cantor gave independent constructions of the real numbers from the rational numbers during the mid to late 1800s. Cantor considered a natural equivalence relation on Cauchy sequences of rational numbers with the resulting cosets representing abstract real numbers. It turns out that Cantor's ideas can be modified and applied to sequences of real numbers - via ultrafilters - in order to give an explicit construction of non standard (or hyperreal) numbers. The purpose of this talk will be to develop both constructions (reals and hyperreals) and to explain some non standard principles which arise in the process.

Laurie de Castro
see Ana Burgers

Orianna DeMasi, McGill University

It's a Coyote-Eat-Deer-Feed-Tick World: A Deterministic Model of Predator-Prey-Parasite Interaction in the Northeast

Occurrences of Lyme disease have dramatically increased since the the 1970's. Much research focuses on controlling Lyme through ticks, the vector for the disease, or white-tailed deer, their host. Deer populations are dense in the Northeast and it is thought that decreasing deer density will decrease tick density and thus Lyme. We look at the potential for reduced Lyme by coyotes biologically controlling deer populations through predation. We develop a deterministic model and investigate the long term deer-coyote interactions. The model is explored analytically and numerically and predicts that significant human intervention will be needed to control deer. Numerical simulations of possible culling programs are thus provided to guide policies.

Jennifer Diemunsch, University of Dayton

Paley Graphs: Exploring Transitive Sub-tournaments and Clique Numbers

The Paley graph $P(q)$ is a graph with vertex set $GF(q)$ with an edge from a to b if and only if $b - a$ is a quadratic residue of $GF(q)$. The properties of Paley graphs have broad applications to graph theory, number theory, and theoretical computer science. When q is a prime congruent to $1(\text{mod } 4)$, $P(q)$ is an undirected graph, and when q is a prime congruent to $3(\text{mod } 4)$, $P(q)$ is an orientation of the complete graph on q vertices, better known as a tournament. Let $\omega(P(q))$ denote the largest clique or transitive subtournament of the Paley graph P, and let $L(q)$ denote the smallest positive integer that is not a quadratic residue of q. In this talk we investigate the inequality $L(q) \leq \omega(P(q))$ for $q \leq 1000$ and how $L(q)$ could be used to bound or determine $\omega(P(q))$. In addition we consider how this inequality might give insight to two related open problems, one number theoretic and the other graph theoretic.

Angela Duncan, Arkansas State University, Jonesboro

Self Efficacy in Developmental Mathematics

The purpose of this study is to determine whether self-efficacy differentiates developmental mathematics students from college algebra students. It will take a brief look at how technology, age, and gender make a difference in a developmental students self-efficacy. This study will take an in depth look at whether the Hawkes algebra system that Arkansas State University uses to teach developmental mathematics courses is an effective way to teach these courses. This research could eventually serve as a model for intervention techniques that may assist developmental students in becoming more successful mathematics students.

Claudia Falcon, University of North Carolina at Chapel Hill

Spheres Passing Through the Interface of Stratified Corn Syrup

Settling rates of particles through stratified fluids affect many aspects of life, from air quality to distribution of biomass in the upper ocean. We study the behavior of a sphere falling through a two-layer stratification of miscible viscous fluids. Motivated by the above applications and by the levitation and velocity reversal found in similar saltwater experiments, we focus on the low Reynolds number regimes. This simplifies the physics by making the fluid inertia negligible, which is reflected mathematically by the linearization of the governing motion equations, thus making them more accessible to analysis and numerics. In this experimental study, we use corn syrup, a highly viscous fluid, to match this approximation. Due to the nature of corn syrup, we must heat the corn syrup, stir in distilled water until homogeneous, and then allow to cool overnight to room temperature. We have developed methods to prevent evaporation. The analysis of these experiments provides us with a velocity profile. In this regime, we find a novel phenomenon in which the sphere slows down beyond the terminal velocity of the bottom layer. This behavior is dictated by the complicated interplay between the entrained fluid and the downward moving sphere. We can emphasize this effect in a tortoise-and-hare like race, in which a sphere falling in a tank of stratified fluid exhibits a longer travel time than a sphere falling the same distance in a tank of only the bottom denser fluid. Our experiments have revealed other interesting phenomena, including studies of the wall effects, convection, entrainment, and reflux.

Kerensa Gimre, Pacific University

Under the Sea ... the Coastline Will Be

In response to the 2008 International Mathematical Competition in Modeling problem, "Take a Bath," we seek to model the consequence of higher temperatures on sea levels worldwide. We specifically design models describing the results of global warming on the state of Florida and assuming that sea levels worldwide will be equally affected by the melting of the Arctic ice cap. From basic thermodynamic principles we calculate the mass of ice lost yearly at the Arctic, the consequent rise in sea levels, and demonstrate how Florida coastal cities will suffer due to this rise. We develop three models of pollution levels for the next fifty years and use them to analyze various scenarios of how the world will respond to global warming. Our paper received a Meritorious Ranking and was chosen as one of the top twenty papers from the United States.

Kathryn Gravelle, Nazareth College of Rochester

Mathematical Literature

Children's Literature provides a vast collection of stories that can be used in a variety of Mathematics lessons. In this talk, we will look at what makes a text a good selection to use for teaching mathematics and how to incorporate literature into a mathematics lesson. Of course, we will also look at a variety of texts that are good to use in teaching specific areas of mathematics.

Shira Hetz, Texas A&M University

From Simple Continued Fractions to Lambda Fractions

Simple continued fractions provide a useful way to approximate a given real number using nested fractions with positive integer denominators. Motivated by geometric concerns, D. Rosen studied the properties of generalized continued fraction expressions where the integer partial quotients are replaced by integer multiples of an algebraic number, $\lambda_q = 2\cos\frac{d\pi}{q}$ for an integer $q > 3$. Following Rosen's construction, we consider $\lambda = \sqrt{d}$, for d a positive, square-free integer. Our work has yielded an explicit characterization of the $\sqrt{d}$-fraction of units in the ring of integers in the real quadratic fields $\mathbb{Q}(\sqrt{d})$. In this talk, we will introduce simple continued fractions and their fundamental properties. Furthermore, we will show which properties carry over to λ-fractions, and conclude with the unique representation of an arbitrary unit as an infinite $\sqrt{d}$-fractions.

Jessica Jakositz, Gettysburg College

Subsets of the Group $\mathbb{Z}_{70}$ with Generating Number 3 and Independence Number 5

Let A be a subset of $\mathbb{Z}_n$, where $|A| = m$ and A is s-generating and t-independent, with $t = 2s - 1$. The smallest choices of n, t, s, and m for which we do not know of the existence of such a set are $n = 70$, $t = 5$, $s = 3$, and $m = 4$. In this paper we determine whether a subset A of $\mathbb{Z}_n$ of size 4 with gen A=3 and ind A=5 exists.

YoungJu Jo, Illinois Institute of Technology

Orthogonal Art Gallery with Holes

The original art gallery problem (V.Klee,1973) asked for the minimum number of guards sufficient to see every point of the interior of an n-vertex simple polygon. Chvátal (1975) proved that $\lfloor n/3 \rfloor$ guards are always sufficient. If all the edges of the given simple polygon are either horizontal or vertical, then such a polygon is called an orthogonal gallery. Kahn, Klawe and Kleitman (1983) proved that $\lfloor n/4 \rfloor$ guards are sufficient for such a n-vertex gallery. We are interested in orthogonal gallery with holes, i.e, an orthogonal polygon enclosing some other orthogonal (interior of each hole is empty). In 1982, Shermer conjectured that any orthogonal polygon with n vertices and h holes can be guarded by $\lfloor n/4 + h/4 \rfloor$ guards. This conjecture remains open. The best known result shows that $\lfloor n/4 + h/2 \rfloor$ guards suffice (O'Rourke 1987). In this talk we will discuss the history of these problems and some of the proofs we will outline our approach to proving that $\lfloor n/4 + 5h/12 \rfloor$ guards suffice for our orthogonal gallery with n vertices with h holes. This is joint work with Prof Hemanshu Kaul.

Samantha John, Columbia University

Predicting Exchange Rates using Artificial Neural Networks

Foreign exchange rates affect nearly every sector of global finance. The goal of the project was to create a model to forecast foreign exchange rates between the United States dollar (USD) and eight other currencies. During the course of the project we attempted to build a model that could use 90% of a given data set for learning to forecast the other 10%. We explored linear versus nonlinear, regression versus neural networks, state space search versus paramater space search, as well as homogenous versus heterogenous data sets. We found that an artificial neural network using a state-space search algorithm and the heterogeneous data set gave the best model for our data.

Ruttika Joshi, New Jersey Institute of Technology

Interest Rate Swaps

The history of financial instruments began only about half a century ago with the trading of financial derivatives in stock exchanges. Interest rate swaps came even later; some where around 1981; when the World Bank and IBM Corporation traded interest rates to meet their specific needs while abiding by the borrowing limits that the global economies had set for themselves. Interest rate swap is a financial derivative in which the two parties involved in a swap exchange cash flows of interest payable on a certain principal amount. The whole point of exchanging cash flows is maximizing profit and minimizing the risk associated with floating interest rates attached to loans. Although the ultimate aim of interest rate swaps is similar to that of commodity swaps, both these financial derivatives function differently. This paper shall explain the mathematics behind interest rate swaps, how they work with a cash flow at hand and how they differ when a dealer steps in. Further, the paper shall attempt to come up with a solution for just the right amount of interest rate that a corporation may swap to minimize risk and maximize profit.

Sarah Khasawinah, Bryn Mawr College

Evaluation of Hypersingular Integrals Using Numerical Methods

The hypersingular integral naturally appears in science areas such as acoustics and electromagnetics. However, this integral cannot be solved analytically because it contains a puncturing singularity point, and thereby fails to meet the basic requirements of Reimann integration. Therefore along with my partner at the US-Hong Kong REU, I strived to approximate the value of these integrals by appealing to various numerical methods. We built upon basic numerical techniques such as the trapezoid Rule and Simpson's Rule to develop algorithms that solve hypersingular integrals of second and third order, irregardless of the location of the singularity.

Susie Kimport, Bowdoin College

An Algorithm for Computing Word Length in Thompson's Group F

Thompson's group F is an infinite group whose elements can be interpreted in three different yet equivalent ways: algebraically through group presentations, analytically as homeomorphism of the unit interval, and geometrically as binary rooted tree pair diagrams. My project is to find a practical algorithm for computing word length with respect to a certain kind of generating set. This algorithm is based on a theoretical method introduced in 2007.

Nicole Kingsley, State University of New York at Geneseo

Generating and Breaking Simple CAPTCHAs Using MATLAB

Have you ever visited a website where you were prompted with an image, most likely including a block of letters or a sequence of words, from which you were asked to decipher the text and submit it back in order to proceed? Most likely, you have. These images are called CAPTCHAs, or Completely Automated Public Turing tests to tell Computers and Humans Apart, and are common attempts at preventing computerized hacking and spam attacks on popular websites. We will generate some simple CAPTCHAs using MATLAB, and focus on an algorithm that has proven successful in decoding these basic CAPTCHAs.

Katelynn Kochalski, Canisius College

Wallis's Product

In 1656 the English mathematician John Wallis gave an extraordinary formula which expressed $\pi/2$ as an infinite product. The purpose of this talk will be to derive Wallis's formula and to comment on its connection to other important developments in the mathematical sciences.

Xinwei Luo, Indiana University of Pennsylvania

The Study of Short Interest Ratio of Stock with Stochastic Volatility: A naked short sale restriction in the stock market to attain a "balance"

Short sale stock is a practice of selling stocks, which is used by investors who try to profit from the falling price of a stock. It can be beneficial in enhancing liquidity in the securities market, however, it is sometimes used for market manipulation, which can damage companies and even threatens the broader markets. This project works on finding out the short interest ratio of a stock with stochastic volatility in market to keep its price fluctuation within five percent variation without being shorted and to restrict naked short sellers from manipulating the stock price.

Claire McCall, University of Montevallo

When Are the Real Roots of a Monic Cubic Polynomial Fundamental Units?

Let $f(x) = x^3 + ax^2 + bx + 1$ be a monic cubic polynomial with integer coefficients a and b such that the following conditions hold: $f(0) = 1$, $f(x)$ is irreducible in $\mathbb{Z}[x]$ and $f(x)$ has three distinct real roots. Given a root u of $f(x)$, our research found the conditions under which $|u|$ is a fundamental unit of the order $\mathbb{Z}[x]$. We found that the set of ordered pairs (a, b) is symmetric. This fact and previous work by Thomas limited to three families of ordered pairs the possible ordered pairs for which $|u|$ is a fundamental unit. For these three families $|u|$ is a fundamental unit, except for one ordered pair in one of the families.

Kati McConville
see Ana Burgers

Allison Mettler
see Sarah Bailey

Laine Noble, Tulane University

p-Adic Valuations of Integer Sequences

We explore structure in the p-adic valuations of integer sequences satisfying recurrence relations, in particular the Stirling numbers. We also examine asymptotic analysis and error for sequences satisfying first order recurrences.

Katy Nowak
see Ana Burgers

Megan O'Connor, Western Michigan University
Elizabeth Zapata, California State University, Chico

An Examination of the Social Class Backgrounds of California's Mathematics Professors

As part of an NSF sponsored 6-week REU (Research Experience for Undergraduates) program, the Mathematics Education research group at California State University, Chico surveyed 957 University of California (UC) and California State University (CSU) tenured/tenure-track mathematics professors on their social class backgrounds. In this talk we will present our findings and discuss the implications for UC and CSU mathematics students access to class-specific role models, and, how mathematics professors from lower social class backgrounds may help Californias efforts to increase the number of students concentrating in mathematics.

Allison O'Hair, University of California, Davis

On the Geometric Structure of Spanning Trees

Spanning trees are an important and widely used concept of graph theory. The graph of tree exchanges is a large graph whose nodes are the spanning trees of a graph. Two of these spanning trees are adjacent if a simple edge replacement occurs. I present several properties of the graph of tree exchanges. I will also present an efficient program that finds the minimum spanning tree for a graph with respect to two sets of edge costs over a convex function. Although the program could potentially only locate a local minimum, it locates the global minimum in almost every trial.

Meagan Potter, Pacific University

Designing Matroids: Discovering the Relationships between Designs and Matroids through Geometries

Design theory and matroid theory are two fields of discrete mathematics introduced in the early 1930s. Some designs are matroids and some matroids are designs; both have connections to geometry so we use geometries to link the two structures. Affine planes give rise to $(n2 + n, n2, n + 1, 1)$-designs, projective planes give rise to $(n2 + n + 1, n + 1, 1)$-designs, and all projective geometries are matroids. The Fano plane is also the Fano matroid and the (7, 3, 1)-design. By considering this example, we investigate the relationship between specific components of the three structures and develop a method of translating among them. Using these associations, we find other matroids give specific designs. We consider the implications of the correlations from these specific examples and seek to make general conclusions about the nature of matroids from general balanced incomplete block designs (BIBDs) and symmetric BIBDs.

Bette Catherine Putnam, University of Mississippi

On Generalized Mersenne and Fermat Primes

The classical Mersenne and Fermat primes are, respectively, primes of the form $2^k - 1$ and $2^k + 1$. The Mersenne primes have been studied since antiquity. It is known that if $2^k - 1$ is prime then k is prime. As of September 2008, there are forty-six such primes known. Fermat primes, of the form $2^k + 1$, seem to be more rare. It is known that if $2^k + 1$ is prime, then k must be a power of 2. To date only five integers of this form are known to be prime. My work involves generalized Mersenne and Fermat primes (If $b^k - a^k$ is prime, where a, b, and k are positive integers with $a \leq b$ and $k \geq 3$, then $b^k - a^k$ is a generalized Mersenne prime). I have been able to prove several analogues to known theorems on Mersenne primes.

Arunima Ray, SUNY Geneseo

Developing Algorithms for the Determination of Relative Peptide Abundances from LC/MS Data

The efficacy of various treatments can depend greatly on a patients proteome, that is, the types and amounts of proteins present. Quantifying the differences in the abundances of proteins among patients is an important step towards individualized treatments. Our modular approach to determine the relative abundance of peptides across samples based on Liquid Chromatography/Mass Spectrometric images has yielded promising results on samples with known amounts of purified proteins as well as samples of a human epithelial carcinoma cell line system. We have also done some preliminary work on protein quantification and assigning confidences to the ratios calculated by our algorithms.

Jolie Roat, Nazareth College of Rochester

Polynomial Parametric Curves in Two Dimensions

In this talk, we will examine polynomial parametric curves in two dimensions as well as the concept of affine algebraic varieties. In addition, we will explore the relationship between a polynomial parametric curve and an affine algebraic variety.

Bianca Rodriguez, University of Texas at San Antonio

Spatial Network Topology

Everyone experiences a blackout at one point in their lives and on the afternoon of August 14, 2003, the Northeast region of the United States of America and part of Canada experienced the largest blackout in history. Millions of people went without electricity for over a day. Living in an age where we are so dependent on electrically powered technology, an event like this is problematic to say the least. This event is one example of an aging infrastructure being heavily used daily and its supplies are not always able to meet the demands. This case study attempted to improve the current network models by incorporating the spatial characteristics for the Texas power grid network, and modifying properties already established prior to our work. The study included the calculations of the relational properties of the network, as well as the calculations of the modified spatial properties of the network. We have ideas on how modifications can be done to improve current models. This work was done with Crista Moreno, University of Washington, Seattle, and supported by the RUSIS project, directed by Javier Rojo, through NSF REU site grant DMS-0552590 and NSA REU grant H98230-06-1-0099.

Amanda Schaeffer, University of Arizona

Strong Reality in Coxeter Groups

Coxeter Groups, sometimes called re ection groups, are groups generated by elements of order 2. Given a subset of these order 2 generators, we can generate a subgroup. This type of subgroup is called a parabolic subgroup. We examine whether every element in the normalizers of these parabolic subgroups is strongly real, in the sense that it can be written as the product of two elements of order at most 2.

Sage Schissel, Wartburg College

Word Recognition Using Daubechies Wavelets

Word recognition is used by many companies and services for automated calling; however, it is an inexact science that contains many problems. To better understand this system and its problems, we created a model that used Haar wavelet decomposition to retrieve the details of different sound recordings of words. We then used our model and intial, known data to identify the data of an unknown word and studied the results.

Caitlin Spilinek
see Sarah Bailey

Emily Stark, Pomona College

Intrinsically Triple Linked Graphs in RP^3

Using a strict definition of the unlink, it has been shown that the complete set of minor-minimally intrinsically linked graphs in arbitrary 3-manifolds is characterized by the seven Petersen-family graphs. We explore a weaker definition of unlinks in projective space, which leads to two distinct two-component unlinks. In particular, six of the seven Petersen-family graphs can be embedded linklessly in RP^3. Flapan, Naimi, and Pommersheim showed that every spatial embedding of K_{10} contains a non-split three- component link (K_{10} is intrinsically triple linked). We show that K_{10} is intrinsically linked in RP^3 as well.

Kaylee Sutton, John Carroll University

Using Hyperbolas to Approximate Square Roots

We will show how point with integer coordinates on the graphs of hyperbolas can be used to approximate square roots of primes. Interesting applications of Fermat's little theorem and Wilson's theorem will be used to show that these approximation methods work better for about half the primes.

Eteri Svanidze, State University of New York at Fredonia

Permutation Codes

Data storage is one of the most concerning issues nowadays with an increasing dependence on real-time data accessibility and availability. It is necessary to minimize occupied volume. Data compression is used to reduce size of documents, data and images so that the amount of time and cost necessary for transmitting the data is smaller. A possible way to compress given data is to use permutation codes. In this work, some characteristics and properties of permutation codes are investigated. In particular, we study perfect permutation codes since they may yield relatively good data compression when permutation codes are used.

Heather Thomas, Mesa State College

Voice-Printing Individual Great Horned Owls Using Wavelet Analysis

This past summer I was chosen to participate in an 8-week Research Experience for Undergraduates (REU) through the Willamette Valley Consortium for Mathematics Research (WiVaM). There were four schools that hosted undergraduates as well as current high-school teachers, and each school worked on a different project. All the teams met on Thursdays to present formal and informal results, as well as for social activities. I was chosen to work on a project through the University of Portland (UP) analyzing owl calls using Fourier and Wavelet techniques. We found that the wavelet transform is an attractive tool for gleaning unique information from a signal. This information can then be used to analyze the properties of the owl call and develop a profile for a particular bird. Our primary goal was to affirm the results of a biology student at UP. We will consider the methods we used to obtain our results, as well as the problems we encountered along the way.

Sharon Ulery, Bowdoin College

Random Elements in Thompson's Group F

I will talk about the problem of how to choose an element at random from a given group, and how to make this idea precise via a stratification of elements. The group I will use is Thompson's group F, which is an interesting infinite group.

S. Minerva Venuti, George Mason University

Modeling, Analysis and Computation of Fluid Structure Interaction Models for Biological Systems

This undergraduate research presents mathematical models for the interaction of blood flow through arterial walls which are surrounded by cerebral spinal fluid. The blood pressure on the inner arterial wall is modeled using a Fourier Series approach. The outer part of the arterial wall and the surrounding cerebral spinal fluid will be coupled using appropriate partial differential equations. The fully coupled system will be analyzed using both analytical and computational tools. Applications of the model studied to intracranial saccular aneurysms will be presented.

Sarah Vodzak, Muhlenberg College

Using Absorbing Markov Chains to Model Caterpillar Populations Under Different Environmental Conditions

This project focuses on determining the herbivory rate imposed by caterpillars. Initially, the life cycle of caterpillars was modeled using absorbing Markov chains. The model related the death rates in each stage of the life cycle to the amount of total leaf material eaten over time. Based on this model, late stage caterpillar death rates were used to predict early stage death rates that result in the amount of herbivory observed in nature. This presentation will discuss model formulation and results.

Elizabeth Zapata

see Megan OConnor