Mathfest 2004
Providence, RI

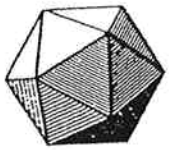
MAA and Pi Mu Epsilon
Student Paper Sessions
August 12–13, 2004

PI MU EPSILON

Pi Mu Epsilon is a national mathematics honor society with over 300 chapters throughout the nation. Established in 1914, Pi Mu Epsilon is a non-secret organization whose purpose is the promotion of scholarly activity in mathematics among students in academic institutions and among staffs of qualified non-academic institutions. It seeks to do this by electing members on an honorary basis according to their proficiency in mathematics and by engaging in activities designed to provide for the mathematical and scholarly development of its members.

Pi Mu Epsilon regularly engages students in scholarly activity through its *Journal* which has published student and faculty articles since 1949. In addition, the society awards monetary prizes for mathematics contests and awards established by chapters.

Since 1952, Pi Mu Epsilon has been holding its annual National Meeting in conjunction with the summer meetings of the Mathematical Association of America (MAA).



MAA Student Chapters

The MAA Student Chapters program was launched in January 1989 to encourage students to continue study in the mathematical sciences, provide opportunities to meet with other students interested in mathematics at national meetings, and provide career information in the mathematical sciences. The primary criterion for membership in an MAA Student Chapter is "interest in the mathematical sciences." Thus, the Student Chapter program supplements, but does not compete with, the chapters of Pi Mu Epsilon. Currently there are approximately 225 active Student Chapters on college and university campuses nationwide. Students are also members of the MAA Sections in their geographic region. Many of the MAA Sections provide special activities for students at their regularly scheduled meetings.

Student Activities
Schedule of Events
All events will be held in the Rhode Island Convention Center (RICC) and the Westin Hotel

Wednesday, August 11

5:30 pm - 6:30 pm	MAA/PME Student Reception	Rotunda, RICC

Thursday, August 12

8:00 am - 11:30 am	PME Council Meeting	Executive Boardroom, Westin
9:00 am - 5:00 pm	Student Hospitality Center	Ballroom A, RICC
1:00 pm - 2:55 pm	MAA Session #1	Bristol Room, Westin
1:00 pm - 2:55 pm	PME Session #1	Newport Room, Westin
1:00 pm - 2:55 pm	MAA Session #2	Kent Room, Westin
1:00 pm - 2:55 pm	PME Session #2	Washington Room,Westin
3:00 pm - 4:55 pm	MAA Session #3	Bristol Room,Westin
3:00 pm - 4:55 pm	PME Session #3	Newport Room, Westin
3:00 pm - 4:55 pm	MAA Session #4	Kent Room, Westin
3:00 pm - 4:55 pm	PME Session #4	Washington Room, Westin
5:00 pm - 5:50 pm	MAA Modeling Contest Winners	Bristol Room, Westin

Friday, August 13

8:00 am - 11:30 am	PME Council Meeting	Executive Boardroom, Westin
9:00 am - 5:00 pm	Student Hospitality Center	Ballroom A, RICC
1:00 pm - 2:55 pm	MAA Session #5	Bristol Room, Westin
1:00 pm - 2:55 pm	PME Session #5	Newport Room, Westin
1:00 pm - 2:55 pm	MAA Session #6	Kent Room, Westin
1:00 pm - 2:55 pm	PME Session #6	Washington Room,Westin
3:00 pm - 5:35 pm	MAA Session #7	Bristol Room,Westin
3:00 pm - 4:55 pm	PME Session #7	Newport Room,Westin
3:00 pm - 5:35 pm	MAA Session #8	Kent Room, Westin
3:00 pm - 4:55 pm	PME Session #8	Washington Room, Westin
6:00 pm - 7:45 pm	PME Banquet	Waterplace Ballroom, Westin
8:00 pm - 9:00 pm	J. Suthlerland Frame Lecture **Joan P. Hutchinson,** Macalester College *When Five Colors Suffice*	Narragansett Ballroom,Westin

Saturday, August 14

9:00 am - 3:00 pm	Student Hospitality Center	Ballroom A, RICC
1:00 pm - 2:50 pm	MAA Student Workshop **Benoit Mandelbrot** *Topics in Fractal Geometry*	RICC 557
3:00 pm - 3:50 pm	MAA Student Lecture **Mario Martelli**, Claremont-McKenna College *The Secret of Brunelleschi's Cupola*	RICC 557
4:00 pm - 4:30 pm	MAA Special Session on *Math Horizons* **Arthur T. Benjamin**, Harvey Mudd College **Jennifer J. Quinn**, Occidental College	RICC 557
4:45 pm - 5:45 pm	Student Problem Solving Competition	RICC 557

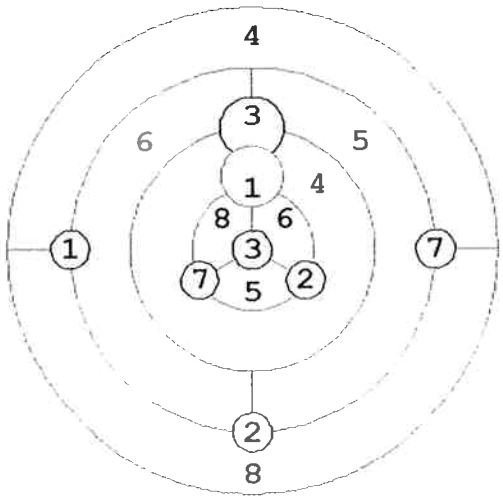
J. Sutherland Frame Lecture

Friday, August 13, 2004
8:00 - 9:00 pm
Narragansett Ballroom, Westin Hotel

When Five Colors Suffice

Joan P. Hutchinson
Macalester College

The challenging four-color conjecture, posed in 1852, asks whether four colors are enough to color the regions of any map so that two regions that share a boundary receive different colors. In 1976 K. Appel and W. Haken proved that "four colors suffice." With some changes to the problem, four colors may no longer be enough. We discuss these variations in which five, not four, colors suffice.



How many colors are needed to color this map? Each country consists of two connected regions, with the two regions numbered the same. Both regions of a country must receive the same color, and adjacent regions must receive different colors.

The J. Sutherland Frame Lecture is named in honor of the ninth President of Pi Mu Epsilon, who served from 1957 to 1966 and passed away on February 27, 1997. In 1952, Sud Frame initiated the student paper sessions at the annual Pi Mu Epsilon meeting, which is held at the Summer Mathfests. He continually offered insight and inspiration to student mathematicians at these summer meetings.

MAA Student Lecture

Saturday, August 14, 2004
3:00 - 3:50 pm
Room 557, Rhode Island Convention Centerl

The Secret of Brunelleschi's Cupola

Mario Martelli
Claremont-McKenna College

How did he do it? In 1420 the architect Filippo Brunelleschi won the competition for building the "octagonal cupola" of Florence's cathedral. His innovative design did not use centering. Brunelleschi built a model to show that his proposal would work, but he categorically refused to reveal his secret. The mystery remains today, but a recent mathematical analysis has been able to lift the veil from parts of Brunelleschi's design. How? Come to the talk to find out.

Pi Mu Epsilon Delegates

Speakers

Name	School	Chapter	PME Session
Serina Alfano	St. Peter's College	NJ Epsilon	6
Melanie Antos	St. Norbert College	WI Delta	7
Holly Attenborough	Miami University	OH Delta	4
Stephanie S.Barille	Mount Union College	OH Omicron	1
Nicholas P. Biller	Occidental College	CA Theta	3
Brian Black	Providence College	RI Gamma	1
Dakota Blair	Texas A&M University	TX Eta	3
Angela Brown	Sam Houston State University	TX Epsilon	5
Nathan Brown	Northwestern University	IL Beta	2
Michael Cortez	Hope College	MI Delta	8
Nicole Cunningham	Youngstown State University	OH Xi	6
Paul Dawkins	Angelo State University	TX Zeta	2
Steve Dinda	Youngstown State University	OH Xi	8
Nathan D. Edington	Hood College	MD Delta	7
John Filkorn	John Carroll University	OH Lambda	4
Henry Gould	Hope College	MI Delta	8
Adam Gray	University of Mississippi	MS Alpha	4
Carly Grey	John Carroll University	OH Lambda	4
Brian Hahn	St. Norbert College	WI Delta	1
Caleb Hallauer	University of Mississippi	MS Alpha	6
Jeremy Hamilton	Youngstown State University	OH Xi	5
Colleen Hughes	Denison University	OH Iota	3
Julie Iammarino	John Carroll University	OH Lambda	5
Adam Kolakowski	St. Peter's College	NJ Epsilon	6
Eric Laber	UCLA	CA Alpha	4
Kristina M. Lund	Grand Valley State University	MI Iota	2
Melissa Marshall	Youngstown State University	OH Xi	5
Ashley Moses	Sam Houston State University	TX Epsilon	1
William Neris	SUNY Fredonia	NY Pi	3
Erin Polsley	Elmhurst College	IL Iota	3
W. Andrew Pruett	Millsaps College	MS Delta	2
Lisa Reeder	New Mexico State University	NM Alpha	7
Jill Schmidt	St. Norbert College	WI Delta	8
Rita Schneider	Fairfield University	CT Gamma	8
Patrick Sigmon	Wake Forest University	NC Lambda	2
Jodi Simons	University of New Hampshire	NH Alpha	6
Theodore T. Stadnik	Youngstown State University	OH Xi	8
Ryan Sternberg	Worcester Polytechnic Institute	MA Alpha	3
Anupama Tippabhotla	University of South Florida	FL Epsilon	1
Sarah Van Asten	St. Norbert College	WI Delta	5
Mark Walters	Miami University	OH Delta	7
Andrew Wells	Hope College	MI Delta	6
Ryan Westbrook	Texas A&M University	TX Eta	7
Alyssa Wood	St. Norbert College	WI Delta	5

Additional Delegates

Aja Johnson	Elon University	NC Nu
Brian Krummel	University of Maryland, Baltimore Cnty.	MD Gamma
Caroline White	St. Louis University.	MO Gamma

MAA Student Speakers

Name	MAA Session	Name	MAA Session
Brandon Batista	5	Meghan Kelley	1
Marisa Belk	1	Robin Koytcheff	8
Elizabeth Bellenot	8	Mark Lane	2
Christina Brakken-Thal	5	David LeRay	5
Kevin Brink	5	Kari Lock	6
Ashley Brown	8	Katherine Magouirk	2
Emily Buessing	6	Alicia Martin	8
Nathanial Burch	3	Nicholas McClure	5
Brian Chen	6	Jacob McMillen	6
Drew Colthorpe	5	Amanda Morris	4
Ivan Corwin	7	Wing L. Mui	8
Adam Cox	6	Ryan Ottman	1
Christy Sue Crouch	6	Shannon Ponek	4
Aubrey da Cunha	8	Caleb Reusser	2
Agata Danielak	3	Andrew Reynolds	2
Matthew Davis	1	Becky Robinson	7
Amy DeCelles	8	Matt Rodrigues	1
Anthony DeLegge	1	Rebecca Russ	4
Christopher Dodd	7	Mary Servatius	1
Shawn Elledge	4	Vojislav Sesum	7
William Espenschied	8	Lauren Shareshian	8
Matthew Fanello	6	Matthew Spencer	3
Rachel Finck	3	Noah Stein	7
Todd Gaylord	1	Colleen Sweeney	8
Matthew Goldfield	8	Dan Tating	1
Richard Gottesman	8	Leya Tesmenitsky	4
André Harmse	4	Abby Van Houten	4
Mohammed Haque	3	Phillip Whitman	4
Stephanie Hurder	7	Kevin Wierzbicki	3
Phakawa Jeasakul	7	Robert Willenbring	8
Anne Jirapattanakul	7	Alice Wilson	8
Pollyanna Jones	2	Jenni Wirth	5
Daniel Kane	7	Zhongtao Wu	3
Matthew Katschke	2	Ya Xu	7

MAA Session #1

Bristol Room (Westin Hotel) **1:00 - 2:57 PM**

1:00-1:15

INTRODUCTION TO KNOTS AND COLORINGS

Marisa Belk
State University of New York - Binghamton

An introduction to the basic principles of knot theory, including: the structure of knots, properties of knots, the importance of invariant operations and colorings. I explore the Kauffman-Harary conjecture by finding the colorability and determinant of a knot using equations, and explaining in what cases the conjecture has been proven.

1:17-1:32

LOOPS AND BANDS

Matthew Davis & Meghan Kelley
West Chester University of Pennsylvania

A popular probability activity involves randomly tying together three strings and recording possible outcomes. We will discuss how to generalize this knot tying activity. To deepen the generalization we modify the experiment by switching from strings to strips of paper and allowing half twists.

1:34-1:49

REGULAR STICK NUMBERS OF $(2,q)$ TORUS KNOTS

Anthony DeLegge
Benedictine University

The $\alpha-$*regular stick number* of a knot K is the minimal number of equal length sticks required to build K in space such that adjacent sticks meet at the angle α. I describe upper and lower bounds in the case that $\alpha = \arccos(-1/3)$ for several $(2,q)$ torus knots.

1:51-2:06

FORMING POLYGONS BY TYING KNOTS WITH RIBBONS

Dan Tating
California State University - Chico

In this presentation, I explore mathematical models for flat knotted ribbons, and make specific conjectures for the least length of ribbon (for a given width) needed to tie $(q+1,q)$ torus knots. My first conjectures give the least length of ribbon to tie $(3,2),(4,3),\ldots,(10,9)$ torus knots. The main conjecture determines a general formula for finding the least length of ribbon to tie a $(q+1,q)$ torus knot, given q and a given width.

2:08-2:23

THE RELATIONSHIP BETWEEN INTRINSIC KNOTTING AND INTRINSIC LINKING

Ryan Ottman & Matt Rodrigues
California State University - Chico

We explore the unsolved question mentioned in Adams' *The Knot Book*: "Will removing a vertex from an intrinsically knotted graph result in an intrinsically linked graph?" We solve the question for several types of graphs, including complete graphs, complete partite graphs and deficient graphs.

2:25-2:40

RELATIONS BETWEEN CROSSCAP NUMBER AND GENUS OF TORUS KNOTS

Todd Gaylord
University of California - Berkeley

B. Clark defined the crosscap number, $c(K)$, of a knot to be the minimum genus of all non-orientable surfaces which span the knot and gave an upper bound for this number as $c(K) \leq 2g(K)+1$ where $g(K)$ is the genus of the knot. The obvious next question is whether an upper bound for the genus exists in terms of the crosscap number. This talk will examine a family of torus knots that show this cannot be the case. I also extend the conjecture to a more general family of knots.

2:42-2:57

MAKING SPIRALS

Mary Servatius
Worcester Polytechnic Institute

A natural geometric element occuring in art and nature is the spiral. In this talk I explore various methods of generating spirals and examine their geometric and artistic features.

THURSDAY AUGUST 12, 2004

PME Session #1

Newport Room (Westin Hotel) **1:00 P.M. – 2:55 P.M.**

1:00-1:15

DRAWING GRAPHS FROM DEGREE SEQUENCES: A COMPUTER BASED APPROACH TO RECURSIVE ALGORITHMS

Brian Black
Providence College – Rhode Island Gamma

We describe a computer based approach to the Havel-Hakimi recursive algorithm based on Euler's handshaking lemma for determining whether a sequence of non-negative integers is graphical. The program determines if a sequence is graphical and draws any resulting graphs. This presentation includes discussion of the problems arising from the computerization of the innate logic humans use to draw graphs.

1:20-1:35

THE IMPACT OF ADDITIONAL DATA VALUES ON STANDARD STATISTICAL ESTIMATORS

Ashley Moses
Sam Houston State University – Texas Epsilon

In this talk we will discuss the impact on statistical estimators resulting from the availability of additional sample data. We will include the impact of single and multiple new values on the sample mean, variance, standard deviation and correlation coefficient, illustrating the results with a specific example.

1:40-1:55

CATCH THE WAVE

Stephanie S. Barille
Mount Union College– Ohio Omicron

What do audio clips, seismographs, electrocardiograms, FBI finger print cards, and El Niño all have in common? Come catch the "wave" and find out!

2:00-2:15

THE MATHEMATICS OF POLARIZED HELIUM

Brian Hahn
St. Norbert College – Wisconsin Delta

The neutron can be a very complicated item to study because it has no charge and is unstable. By using Polarized Helium 3 we are able to study the neutron by appealing to some quantum mechanics and a little bit of math.

2:20-2:35

INTERACTIONS OF KDV SOLITONS, POSITONS AND NEGATONS

Anupama Tippabhotla
University of South Florida – Florida Epsilon

Among integrable equations is the celebrated Korteweg-deVries (KdV) equation which is both nonlinear and dispersive. In this talk I will discuss the various interactions of multisolitons, positons and negatons using Maple. In particular, I will show the interactions of three and four solitons, positons and negatons.

MAA Session #2

Kent Room (Westin Hotel) **1:00 - 2:55 PM**

1:00 - 1:15

THE MATHEMATICS OF FLORENCE NIGHTINGALE

Pollyanna Jones
Sam Houston State University

This talk will trace the life of Florence Nightingale, who was born and raised in Great Britain during the Nineteenth Century. Although women pursuing any type of education were not encouraged, Nightingale not only studied mathematics but flourished and became an important figure who improved health care by inventing the polar-area diagram.

1:20 - 1:35

MATHEMATICAL DEVELOPMENTS IN EARLY CHINESE HISTORY

Mark Lane
Sam Houston State University

This talk will trace the evolution of Chinese mathematics throughout the early dynasties. I will focus on the influence of "The Nine Chapters of Mathematical Art".

1:40 - 1:55

PYTHAGOREAN SOCIETY

Katherine Magouirk
Sam Houston State University

In this talk, I will trace the development of the Pythagorean society. In particular, I will discuss Pythagoras' early life and the beginnings of the society. I will also discuss some of the beliefs and teachings of the Pythagorean society.

2:00 - 2:15

GERGONNE'S SOLUTION TO THE APOLLONIUS PROBLEM

Caleb Reusser
University of Wisconsin - Platteville

A 19th Century solution to a 2000 year old problem is examined. I shall demonstrate how to construct, using compass and straightedge, a circle that is tangent to three other circles in a plane.

2:20 - 2:35

TODAY OR TOMORROW?

Andrew Reynolds
Sam Houston State University

Within the human quest to understand the world we live in, the annual calendar has changed a great deal. I will discuss the mathematical basis for our calendars, the flaws within them, and who designed them.

2:40 - 2:55

SAN GAKU PROBLEMS IN OTHER GEOMETRIES

Matthew Katschke
Ohio Northern University

San Gaku problems are Euclidean problems often involving arrangements of tangent lines and circles, from ancient Japan, that were inscribed on tablets and hung in temples. By exploring the Euclidean proofs of these problems, they can be generalized to spherical and hyperbolic geometry.

THURSDAY AUGUST 12, 2004

PME Session #2

Washington Room (Westin Hotel) **1:00 P.M. – 2:55 P.M.**

The third and fourth speakers in this session are students of Professor Steven Schlicker in the REU program at Grand Valley State University

1:00-1:15

INTUITION VS. FORMALISM IN MATHEMATICS

Paul Dawkins
Angelo State University – Texas Zeta

In a 1986 paper, Chris Freiling used an intuitive argument to prove the Axiom of Choice and the Continuum Hypothesis false. This is impossible formally since they are independent statements. I discuss the conflict between formal and intuitive mathematics in this context and reconcile the conflict Freiling's paper sets up.

1:20-1:35

IDEMPOTENT MATRICES OVER COMMUTATIVE PRINCIPAL IDEAL RINGS

W. Andrew Pruett
Millsaps College – Mississippi Delta

I show that all idempotent matrices over a nowhere reducible commutative principal ideal ring R are diagonalizable with diagonal entries idempotent in R.

1:40-1:55

THE GEOMETRY OF $\mathcal{H}(\mathbb{R}^N)$: PART I

Kristina Lund
Grand Valley State University – Michigan Iota

The collection of all non-empty compact subsets of $\mathbb{R}^n$ forms a complete metric space, $\mathcal{H}(\mathbb{R}^n, h)$ where h is the Hausdorff metric. This space is an important one for several reasons. For example, this is the natural space in which to study fractals. Applications of this metric can be found in image matching, in visual recognition by robots and in computer-aided surgery. In this presentation I will provide essential background information on $\mathcal{H}(\mathbb{R}^n, h)$, and basic results from our efforts to understand the geometry of this space.

2:00-2:15

THE GEOMETRY OF $\mathcal{H}(\mathbb{R}^N)$: PART II

Patrick Sigmon
Wake Forest University – North Carolina Lambda

The collection of all non-empty compact subsets of $\mathbb{R}^n$ forms a complete metric space, $\mathcal{H}(\mathbb{R}^n, h)$ where h is the Hausdorff metric. This space is an important one for several reasons. For example, this is the natural space in which to study fractals. Applications of this metric can be found in image matching, in visual recognition by robots and in computer-aided surgery.
I will share further results from our study of the geometry on $\mathcal{H}(\mathbb{R}^n)$ induced by the Hausdorff metric.

2:20-2:35

INVARIANT METRICS ON LIE GROUPS WITH NON-NEGATIVE CURVATURE

Nathan Brown
Northwestern University – Illinois Beta

So far, all known examples of manifolds with positive curvature rely on the fact that bi-invariant metrics on compact Lie groups have non-negative curvature. At the Williams College SMALL REU, our group has contributed to the search for new examples by finding other invariant metrics on Lie groups with non-negative curvature.

MAA Session #3

Bristol Room (Westin Hotel) **3:00 - 4:57 PM**

3:00 - 3:15

INVARIANT METRICS ON LIE GROUPS I

Rachel Finck
Massachusetts Institute of Technology

We will announce progress towards the classification of left-invariant metrics on Lie groups with nonnegative curvature.[1]

3:17 - 3:32

INVARIANT METRICS ON LIE GROUPS II

Matthew Spencer- *See Abstract Above*
Williams College

3:34 - 3:49

INVARIANT METRICS ON LIE GROUPS III

Zhongtao Wu - *See Abstract Above*
Massachusetts Institute of Technology

3:51 - 4:06

THE METROPOLIS ALGORITHM

Kevin Wierzbicki
Augustana College, Rock Island, Illinois

The Metropolis Algorithm is an example of a Monte Carlo method that uses a Markov chain to generate transitions on a discrete state space subject to certain probability distributions. One example is a variant of the traveling salesman problem, for which I will present a graphical Java program.

4:08 - 4:23

APPLICATIONS OF THE OMEGA TRANSFORM IN ALGEBRAIC GEOMETRY

Mohammed Haque
Columbia College

I will be discussing the Omega Transform and its application to a particular problem in algebraic geometry. In particular, I will introduce this transform, a powerful tool from partition theory, and then show how it can be applied to difficult combinatorial problems that arise from studying covers of algebraic curves.

4:25 - 4:40

HIGHER ORDER LANCZOS' DERIVATIVES

Nathanial Burch
Grand Valley State University

The Lanczos' generalized derivative, developed by Cornelius Lanczos, is a proper extension of the normal derivative. I will show that this derivative satisfies a least squares property and use this result to construct higher order Lanczos' derivatives. Properties of Legendre polynomials and summability kernels play a prominent role in this construction.

4:42 - 4:57

THE MODULI SPACE OF DIHEDRAL COVERS OF THE PROJECTIVE LINE

Agata Danielak
Columbia University

I investigate the moduli space of covers of the projective line with a fixed Galois group and genus. In the case of the dihedral groups, I count the number of components of this moduli space which is equal to the number of restricted partitions whose entries satisfy certain inequalities arising from applying a theorem of Kani and Rosen.

[1] Williams College REU, K. Tapp advisor.

THURSDAY AUGUST 12, 2004

PME Session #3

Newport Room (Westin Hotel) **3:00 P.M. – 4:55 P.M.**

3:00-3:15

CARTESIAN PRODUCTS OF TRIANGLES AS UNIT DISTANCE GRAPHS

Ryan Alexander Sternberg
Worcester Polytechnic Institute– Massachusetts Alpha

The Cartesian product of n triangles is a unit distance graph of diameter n. It is difficult to produce a drawing of such a graph in the plane such that adjacent vertices are unit distance apart. In these graphs, the number of vertices increases exponentially while the diameter increases linearly.

3:20-3:35

COUNTING HUFFMAN TREES

Erin Polsley
Elmhurst College – Illinois Iota

Huffman trees are binary trees used to construct Huffman codes, which are minimal length encodings for messages. All non-isomorphic Huffman trees with n terminal nodes are given for $n = 1, 2, \ldots, 8$. Different properties and patterns are discussed.

3:40-3:55

INTRINSIC LINKING OF K_6

Colleen Hughes
Denison University – Ohio Iota

Any embedding of K_6, the complete graph on six vertices, will have at least one pair of linked triangles, not necessarily constructed of straight lines. In this talk we explore the possibility of constructing straight-line embeddings of K_6 with 1, 3, 5, and 7 pairs of triangles respectively.

4:00-4:15

SOLVING LINEAR RECURRENCE RELATIONS USING GENERATING FUNCTION AND MATRIX APPROACHES

William Neris
State University of New York at Fredonia – New York Pi

In this research, a single linear recurrence relation was solved using both generating function and matrix approaches. The two methods were then extended to solve a system of linear recurrence relations. Comparison of these approaches will be discussed.

4:20-4:35

OSCILLATING PATTERNS IN LANGTON'S ANT

Dakota Blair
Texas A&M University – Texas Eta

It is known through the Cohen-Kung Theorem that using the Langton's Ant algorithm, a single ant cannot oscillate. However certain patterns with multiple ants can oscillate. We present a way to create oscillating patterns with exactly two ants, examples of oscillators, and patterns resembling gliders in Conway's game of Life.

4:40-4:55

SOME VARIATIONS ON THE TENNIS BALL PROBLEM

Nicholas P. Biller
Occidental College – California Theta

We will study variations of the Tennis Ball Problem that generates Catalan, Motzkin and Schröder numbers. We also investigate a recursive formula for counting Motzkin paths with flaws in terms of Motzkin numbers. A combinatorial proof concerning Motzkin paths with two and three flaws will be given.

MAA Session #4

Kent Room (Westin Hotel) **3:00 - 4:55 PM**

3:00-3:15 USING ODE METHODS TO ANALYZE SOLUTIONS OF A NONLINEAR PDE

Phillip Whitman
University of Texas at Austin

I will present some results on solutions of $\Delta u = u^{-\alpha}$. I will define a "tornado sequence" of solutions and outline how to use ODE methods and the maximum principle to rule them out when $0 < \alpha < 1$. This result implies continuity of limits of positive solutions.

3:20-3:35 PATTERNS IN PICK MATRIX PERMUTATIONS

Rebecca Russ & Shannon Ponek
California Polytechnic Institute - San Luis Obispo

Our objective was to find a pattern in the positive semidefiniteness of 3×3 Pick matrices. Specifically, using the research of J. Weinberg we investigated the patterns that existed in the resulting six matrices when the $z_i's$ of a Pick matrix are permuted. We produced three conjectures based on the determinant properties of positive semidefinite matrices. Scrutiny of these conjectures led to counterexamples that prove no relationship exists in regards to the determinants of these permuted matrices. Further investigations into the eigenvalues of the permuted matrices may prove more fruitful.

3:40-3:55 NEW RESULTS ON SHUFFLE GROUPS

André Harmse
California Polytechnic Institute - San Luis Obispo

I will discuss the permutation groups that arise from perfect card shuffles. In particular I will describe one such infinite family and show that they are isomorphic to a more well known family of groups of functions on vector spaces.

4:00-4:15 FROM NUMBER THEORY TO GROUPS VIA GRAPH PEBBLING

Shawn Elledge
Arizona State University

In 1989 Chung used graph pebbling to prove a number theoretic result of Kleitman and Lemke, first conjectured by Erdős and Lemke. Kleitman and Lemke then conjectured group theoretic generalizations of this result. My research aims to use graph pebbling to prove these conjectures for solvable groups.

4:20-4:35 BIFURCATION DIAGRAMS FOR ONE-DIMENSIONAL DYNAMICAL SYSTEMS

Amanda Morris & Abby Van Houten
Haverford College & Muhlenberg College

We will discuss the one-dimensional dynamical systems that we have spent our summer researching, as well as their accompanying bifurcation diagrams. A bifurcation is a change in the number or stability of the periodic points of a family of functions. A bifurcation diagram shows these attracting and repelling periodic points and how they change in terms of the parameter. We will be presenting some interesting examples of bifurcation diagrams we have encountered, as well as proving some of the properties of these diagrams.

4:40-4:55 A GAME BASED ON VERTEX-MAGIC EDGE LABELING

Leya Tesmenitsky
Hobart & William Smith Colleges

Consider a game based on labeling vertices and edges of graphs. For a given graph G, let V be the number of vertices and E be the number of edges. Let the labels available be the numbers in the set $\{1, 2, ..., V + E\}$. Two players take turns labeling vertices and edges in the graph with single non-repeated labels. The first time a vertex and all the edges incident to it are given labels, the sum of those labels becomes the magic constant k. From that moment on, any time a vertex and the edges incident to it are all labeled, the sum of the labels must be k. The goal of the game is to be the last person to make a move on the graph. If a graph has certain properties, a particular player can have a winning strategy. I will present two previously known strategies as well as new strategies I have developed.

PME Session #4

Washington Room (Westin Hotel) **3:00 P.M. – 4:55 P.M.**

3:00-3:15

CODING MESSAGES
Carly E. Grey
John Carroll University – Ohio Lambda

We will discuss Public Key Encryption with a number of examples using small primes.

3:20-3:35

DIOPHANTUS MEETS TRIGONOMETRY
John Filkorn
John Carroll University – Ohio Lambda

When is the value of a certain trigonometric expression equal to the reciprocal of a square? This problem led me on quite an excursion into number theory. Let's look at some of the highlights of this trip.

3:40-3:55

FUNCTIONS CONCERNING DISTANCES BETWEEN PRIMES
Adam Gray
University of Mississippi – Mississippi Alpha

Many number theoretic ideas can be formulated in terms of the following functions:

$$f(n) = \min\{a \mid n + a \text{ is prime}\}$$
$$g(n) = \min\{a \mid n + a \text{ and } n - a \text{ are prime}\} \text{ if } a \text{ exists, otherwise } g(n) = \infty.$$

I will discuss the formulations of Bertrand's Postulate and the Goldbach and Twin Prime Conjectures in terms of these functions.

4:00-4:15

WHAT'S THAT REMAINDER?
Holly Attenborough
Miami University – Ohio Delta

Lucas's Theorem (1887) finds the remainder of Pascal's Triangle entries when divided by prime numbers. Thus, the theorem gives a computational way to find the remainders of binomial coefficients upon division by a prime. I will illustrate the theorem with examples and if time permits, briefly discuss a proof.

4:20-4:35

THE RIEMANN ZETA FUNCTION
Eric Laber
UCLA – California Alpha

I will give a brief introduction to the Riemann zeta function, stating some of its basic properties. The main result in the presentation is the meromorphic continuation to the entire complex plane. I conclude by stating the functional equation and introducing the Riemann Hypothesis.

MAA Session #5

Bristol Room (Westin Hotel) **1:00 - 2:55 PM**

1:00 - 1:15

WAVELETS IN OBJECT RECOGNITION

Drew Colthorp & Kevin Brink
Grand Valley State University & University of San Diego

Wavelets can be used in industrial and military applications such as machine or robot vision, character recognition, image indexing or retrieval, data hiding, and shape recognition. We present the results of our research using wavelets to recognize shapes such as airplanes in aerial photo images.

1:20 - 1:35

BIFURCATION ANALYSIS OF THE MORRIS-LECAR EQUATIONS

David LeRay
Worcester Polytechnic Institute

The research involved a bifurcation analysis of the practical range of the Morris-Lecar equations. These differential equations are used to model membrane channels and action potentials in neuron cells. The research was carried out as part of a Research Experience for Undergraduates program at Cornell University during the summer of 2004.

1:40 - 1:55

WHITE BLOOD CELL MODELS AND CHEMOTHERAPY

Christina Brakken-Thal
Williams College

I refined a white blood cell model to include a more biologically accurate granulocyte-colony stimulating factor (G-CSF) mechanism and a chemotherapy component using a system of differential equations. I investigate the model under different chemotherapy and G-CSF stimulant regimens. I also investigate possible cyclical behavior of the model.

2:00 - 2:15

MODELING THE INTERNAL PHYSICAL PARAMETERS OF PHOTOVOLTAIC DEVICES

Brandon Batista
Monmouth Regional High School

Photovoltaic devices are sensitive to changing environmental conditions. Temperature and light intensity can have serious effects on their internal physical parameters. In order to extract and understand the physical properties of these parameters, a mathematical model was developed. The model was implemented using the Newton-Raphson method and the results validated applying nonlinear regression analysis techniques.

2:20 - 2:35

DRIVING MATHEMATICALLY

Jenni Wirth
St. Norbert College

I will discuss a driving strategy for minimizing fuel consumption and driving times.

2:40 - 2:55

A POPULATION MODEL OF DISPERSAL AND EXTINCTION

Nicholas McClure
St John's University

I developed a meta-population model that allows dispersal among discrete patches, which are subject to random extinction events. I will discuss how different population parameters affect total population. I will also discuss how various geometrical patch arrangements affect model outcomes.

PME Session #5

Newport Room (Westin Hotel) **1:00 P.M. – 2:55 P.M.**

1:00-1:15

MATHEMATICS IN ADAPTIVE EDUCATION

Sarah Van Asten
St. Norbert College – Wisconsin Delta

Adaptive education refers to teaching students with disabilities. We will discuss various methods for teaching elementary mathematics to students with certain disabilities.

1:20-1:35

MATHEMATICAL ESPIONAGE: BREAKING THE "UNBREAKABLE" ENIGMA CODE

Alyssa Wood
St. Norbert College – Wisconsin Delta

We will discuss the mathematical methods by which the Allies broke the Enigma Code during World War II. We will also highlight some of the influential men and women who worked for the Allied forces to develop methods of decrypting. A short history of the cryptanalytic *bombe* will also be discussed.

1:40-1:55

KNOT YOUR USUAL TALK ABOUT CELTIC ART

Angela Brown
Sam Houston State University – Texas Epsilon

Two knots are equivalent if their projections can be transformed into one another through a sequence of Reidemeister moves or planar isotopies. The classification of knots is an open question. This talk will apply known and well-developed methods to the classification of some examples of Celtic knots.

2:00-2:15

TRANSFORMING THE MAA INTO A SOCCER BALL

Julie Iammarino
John Carroll University – Ohio Lambda

After showing how to make a soccer ball out of the MAA, generalizations of geometric properties will be explored.

2:20-2:35

VIEWING THE WORLD THROUGH THE "i'S" OF COMPLEX NUMBERS

Melissa Marshall
Youngstown State University – Ohio Xi

Cartographers use many different techniques to construct maps of the world. I will explain the stereographic projection and use it to view points on the globe as points on a two dimensional map. I will also use the stereographic projection to illustrate some surprising results from complex analysis on the Riemann sphere.

2:40-2:55

FUN WITH INCIRCLES

Jeremy Hamilton
Youngstown State University – Ohio Xi

An interesting property regarding an incircle and three related circles will be examined. This problem (11046) was proposed by Christoph Soland in *The American Mathematical Monthly*, November 2003.

MAA Session #6

Kent Room (Westin Hotel) **1:00 - 2:57 PM**

1:00-1:15

AREA AND PERIMETER OF A PLANE REGION BOUNDED BY TWO CLOSED, SIMPLE AND PARALLEL CURVES

Adam Cox (joint work with Christopher Jones & Allison Westfahl)
Claremont McKenna College

We assume that the boundary of a plane region $\mathcal{R}$ consists of two simple, closed, continuous, and parallel curves I and E. We assume that I is contained in the bounded complement of E, and it is smooth, except possibly in countably many points. We determine the area and the perimeter of $\mathcal{R}$ as function of the length of I and the thickness of $\mathcal{R}$.

1:17-1:32

FINDING ABC TRIPLES

Brian Chen
California Polytechnic Institute - Pomona

Rad(n) is the product of the distinct prime factors of n. I endeavor to find natural numbers a, b, c that are relatively prime to each other, where $a + b = c$ and c is greater than Rad(abc). This has applications dealing with the abc conjecture which was first formulated by Joseph Oesterle and David Masser and has connections to Fermat's Last Theorem. I will show that there are an infinite number of solutions and give the form for some of these solutions.

1:34-1:49

LOADED DICE

Emily Buessing
Sam Houston State University

I will determine the fairness of casino dice that have been retired from the tables and altered by placing a divot in one side of the die. I will also look at the location of the defect and determine a rejection region where the die is no longer fair.

1:51-2:06

OPEN SOURCE SOFTWARE AND MATHEMATICS

Matthew Fanello
Augustana College, Rock Island, Illinois

Open source software is created and supported by a community in a process analogous to peer-review in the creation of mathematics. I discuss this process and highlight some of the currently available open source software for mathematics.

2:08-2:23

AN INTRODUCTION TO THE MATHEMATICS OF JUGGLING

Jacob McMillen
State University of New York - Fredonia

I begin by presenting the elementary definitions and tools used in the classification and enumeration of juggling patterns. Any simple juggling pattern can be represented by a sequence of positive integers. I will discuss basic conditions that determine when such a sequence represents a jugglable pattern.

2:25-2:40

COLORING WITH HAMILTON AND TATE

Christy Sue Crouch
Sam Houston State University

One use of Origami in mathematics is to build interesting three-dimensional polyhedra. The question is then raised whether the polyhedra can be properly colored. This talk will use some specific examples to demonstrate the well-known connections among origami, Tait's theorem, and graph theory.

2:42-2:57

SIMULTANEOUS APPROXIMATION OF GENERALIZED GOLDEN RATIOS

Kari Lock
Williams College

Given a set of irrationals, we wish to simultaneously approximate each with a rational number, using the same denominator. What are the "best" denominators for these rational approximations? By finding solutions to a Diophantine equation, I answer this question for generalized golden ratios in the same quadratic field.

PME Session #6

Washington Room (Westin Hotel) **1:00 P.M. – 2:55 P.M.**

1:00-1:15

COMPARING THE EIGENVALUES OF PRODUCTS OF MATRICES

Nicole Cunningham
Youngstown State University – Ohio Xi

Suppose that A and B are two matrices. Even when both products AB and BA are defined, it is seldom the case that these products are equal. In fact, if A is an $n \times m$ matrix and B is an $m \times n$ matrix, the products AB and BA are not even of the same type. In this talk we consider the eigenvalues of these products and see that the products are not as dissimilar as they first appear.

1:20-1:35

COUNTING SYMMETRIC MATRICES OF RANK ONE AND TWO

Andrew Wells
Hope College – Michigan Delta

Rank is one of the most important properties of a matrix. This talk focuses on counting the number of rank one and two matrices in certain vector subspaces of the space of all $n \times n$ symmetric matrices. This question is connected to the study of quadratic forms. The final results classify all possibilities for the space spanned by four 4×4 symmetric matrices.

1:40-1:55

RUBIK'S CUBE

Serina Alfano and Adam Kolakowski
St. Peter's College – New Jersey Epsilon

Our presentation is an introduction to group theory via Rubik's Cube. Our ultimate goal is to solve the deceptive cube with the help of algorithms and some group theory. Solving the Rubik's Cube puzzle is separated into five steps, each a building block of functions and important mathematical content.

2:00-2:15

EUCLIDEAN PROBLEMS IN SPHERICAL AND HYPERBOLIC GEOMETRY

Jodi Simons
University of New Hampshire – New Hampshire Alpha

We consider several geometric problems in the Euclidean plane, including some ancient Japanese temple problems, and explore their analogs in spherical and hyperbolic geometry. We examine their Euclidean proofs to discover how to generalize them to these other geometries. We also explain the basics of spherical and hyperbolic geometry.

This research is the product of joint work with Matt Katschke, Ohio Northern University. Both are students of Dr. Will Dickinson in the REU program at Grand Valley State University.

2:20-2:35

SINES, COSINES AND CONJUGATES

Caleb Hallauer
University of Mississippi – Mississippi Alpha

A nonconstant integer polynomial $f(x)$ is said to be irreducible if in every factorization of $f(x)$ into a product of integer polynomials, one factor is constant. Numbers α and β are said to be conjugates if they are roots of the same irreducible polynomial. I seek angles whose sine and cosine are conjugates. For example $\sin(\pi/8)$ and $\cos(\pi/8)$ are roots of $8x^4 - 8x^2 + 1$. Some interesting classes of such angles are located and studied.

FRIDAY AUGUST 13, 2004

MAA Session #7

Bristol Room (Westin Hotel) **3:00 - 5:35 PM**

3:00-4:30 WILLIAMS COLLEGE REU, C. SILVA ADVISOR

ON CONSTRUCTIONS OF RANK ONE MIXING TRANSFORMATIONS
Becky Robinson - Williams College

Rank One transformations constitute a simple class of cutting and stacking transformations. However, they have been shown to possess strong properties such as mixing. I will offer a brief introduction to the field, survey known techniques for constructing such mixing transformations, and then offer some new examples of mixing transformations.

ON CONSERVATIVITY OF PRODUCTS OF INFINITE MEASURE-PRESERVING TRANSFORMATIONS
Phakawa Jeasakul - Williams College

In finite measure, every measure-preserving transformation is conservative. However, this fact is not necessarily true in infinite measure. I study conditions for conservativity of products of infinite measure-preserving staircase transformations. I also provide some examples of these staircase transformations.

Z EXTENSIONS IN INFINITE MEASURE PRESERVING TRANSFORMATIONS
Anne Jirapattanakul - Williams College

I review the notions of weak mixing for the case of finite measure preserving transformations. Power weakly mixing extends this notion to the case of infinite measure preserving transformations. I study this concept in the context of Z extensions of rank 1 transformations in infinite measure.

GROUP EXTENSIONS OF RANK 1 TRANSFORMATIONS
Christopher Dodd - University of Chicago

This talk will give the basic definitions and examples of group extensions of rank 1 transformations, as well as some constructions and machinery used for more general proofs. I will indicate some of the general theorems known in the field, and will point the way towards the results obtained by our group this summer.

GROUP EXTENSIONS OF RANK 1 TRANSFORMATIONS PART II
Daniel Kane - Massachusetts Institute of Technology

I study the mixing properties of a class of group extensions of rank 1 transformations. I will establish sufficient conditions for these transformations to have properties such as double ergodicity and power weak mixing.

DIFFERENCE SEQUENCES AND ERGODIC THEORY
Noah Stein - Cornell University

Given a set A of natural numbers, its difference set is defined as all positive differences between elements of A. It is known that a difference set must intersect all sequences of return times for a finite measure preserving transformation. This talk will focus on properties of difference sequences and their relation to Ergodic Theory.

4:35-5:35 WILLIAMS COLLEGE REU, F. MORGAN ADVISOR

BUBBLES IN MANIFOLDS WITH DENSITY
Ivan Corwin - Harvard University

I explore the question of what form area-minimizing volume enclosures (bubbles) take in Riemannian Manifolds endowed with density. I prove that some double bubbles take the form of Ys in Gaussian Space (Euclidean space with a Gaussian density).

COMPUTER EVOLUTION OF PERIMETER MINIMIZING CURVES IN THE GAUSSIAN PLANE
Ya Xu - Williams College

In this talk I am going to use Brakke's Surface Evolver in the Gaussian plane to simulate the single bubble, double bubble and triple bubble: the least-perimeter ways to enclose one, two or three given areas.

DOUBLE BUBBLES IN SPHERES OF HIGHER DIMENSIONS
Vojislav Sesum - Williams College

It is well known that the area-minimizing way to partition S^n into two given volumes is a $(n-1)$ sphere. The Double Bubble Conjecture says that the area-minimizing way to partition S^n into three given volumes is a "standard double bubble," i.e. three spherical caps meeting at 120 degrees. I prove this conjecture for three nearly equal volumes.

CURVATURE AND SURFACES WITH DENSITY
Stephanie Hurder - Harvard University

Curvature, a fundamental concept in Riemannian geometry, can be extended to the relatively unexplored category of spaces with density. I generalize the curvature of a curve and the mean curvature of a surface to such spaces. I also define the Gauss curvature of two-dimensional surfaces with density and show that the Gauss-Bonnet formula extends naturally to them.

PME Session #7

Newport Room (Westin Hotel) **3:00 P.M. – 4:55 P.M.**

3:00-3:15

A MISSION TO MARS WITH THE HELP OF KEPLER'S LAWS

Lisa Reeder
New Mexico State University – New Mexico Alpha

This is an explanation of how Kepler's laws can be used to calculate the time it would take a mission to venture from Earth to Mars and back. This has special applications for manned missions because of the return and length of time spent on Mars.

3:20-3:35

ARC LENGTH AND SURFACE AREA – ARE WE ON THE SAME PAGE?

Mark Walters
Miami University – Ohio Delta

In calculus, formulas are derived for the length of a curve and the area of a surface. Textbooks often take two different approaches. One approach connects dots to get polygonal approximations, while the other uses tangential considerations. This paper shows that either approach leads to the expected formulas for both curves and surfaces.

3:40-3:55

COMPUTER IMPLEMENTATIONS OF FIVE IMPORTANT APPROXIMATIONS TO PI

Nathan D. Edington
Hood College – Maryland Delta

We briefly introduce the historically significant and often surprisingly beautiful approximations to pi of Wallis, Newton, Gregory, Machin and Ramanujan. We then outline how these approximations were implemented in MATLAB and MathCAD in order to explore and compare the accuracy and rate of convergence of each approximation.

4:00-4:15

PARTITIONING AND POWER SERIES

Melanie Antos
St. Norbert College – Wisconsin Delta

Problem 6A of the 2003 Putnam Exam called for finding a partition of the non-negative integers having certain properties. We will present the solution to this problem and then use power series to prove that the partition is unique.

4:20-4:35

NEW RESULTS IN WAVELET SET THEORY

Ryan Westbrook
Texas A&M University – Texas Eta

We will present surprising new discoveries in wavelet theory that show there's more under the surface.

MAA Session #8

Kent Room (Westin Hotel) **3:00 - 5:35 PM**

3:00 - 3:15 EXPANDER GRAPHS[1]

Matthew Goldfield & Lauren Shareshian
Carnegie Mellon University & New York University

Expander graphs provide models for good communication networks, having few edges and passing information quickly from one node to all others. We will discuss properties of the expansion constant, which measures the graph's efficiency as a communicator, and its relation to the eigenvalues of an associated matrix.

3:17 - 3:42 A TWIN PRIME CONJECTURE FOR POLYNOMIALS & EXPANSION PROPERTIES OF CIRCULANT GRAPHS [1]

Richard Gottesman & Aubrey da Cunha
Brown University & Iowa State University

I describe Chris Hall's recent proof of the following twin prime conjecture for polynomials over a finite field: if $q > 2$, then there are infinitely many pairs of monic irreducibles $f, f+1$ in $F_q[T]$. I then discuss how one might generalize this to triples and beyond.

We apply bounds established by Alon and Milman for the expansion constant, $H(X)$, based on the spectrum of the adjacency matrix X, to circulant graphs.

3:44-3:59 INFORMATION THEORY AND GRAPH PARTITIONING

Robin Koytcheff
Columbia University

The problem of finding the graph partition that minimizes the normalized min-cut is known to be NP-complete. The recently developed information bottleneck solves the problem of efficiently encoding data in polynomial time with high probability. I numerically and analytically investigate the application of information bottleneck methods to graph partitioning.

4:01-4:16 COMBINATORIAL REPRESENTATIONS OF RNA SECONDARY STRUCTURES

Robert Willenbring
St John's University

RNA secondary structures can be represented mathematically as non-crossing set partitions. Michael Waterman's model, involving certain linear trees, produces another representation. I investigate alternative secondary structure representations based on other restricted Catalan families.

4:18-4:33 HOW WELL MDS REPRESENTS DISTANCES IN GRAPHS?

Alicia Martin
Texas Southern University

Multidimensional Scaling (MDS) is a technique, which allows you to gain insight in relations between entities based on similarities or distances. There are countless research problems using MDS, however, this research will focus on how well MDS represents distances in graphs. MDS will provide a visual representation of the pattern of the proximities (i.e., similarities or distances).

4:35-5:07 INTRINSICALLY LINKABLE AND KNOTABLE GRAPHS, I & II

Alice Wilson & Amy DeCelles
State University of New York - Potsdam & University of Chicago

A graph G is intrinsically linked if every tame special embedding of G contains a pair of non-splittably linked cycles. We say that G is intrinsically linkable if, in every regular planar projection of G, there is a way to assign over/under crossings to each double point such that there is a non-split link in the resulting embedding. We analogously define the notion of intrinsic knottability. We consider intrinsic linkability and knottability in order to determine the presently unknown complete set of minor minimal intrinsically knotted graphs. Minors of the Petersen graphs are examined for possible intrinsic linkability and we show that intrinsic linkability is not preserved under vertex expansion and triangle-Y exchanges.

5:10-5:35 POLYNOMIAL AND RATIONAL KNOTS

Mt Holyoke Knot Theory REU, A. Durfee and D. O'Shea advisors

A polynomial (respectively, rational) knot is a polynomial (respectively, rational) map $\mathbf{R} \to \mathbf{R}^3$ which is an embedding. We will present results related to construction methods and knot theoretic properties of polynomial and rational knots.
REU Members: Elizabeth Bellenot, Ashley Brown, William Espenschied, Wing L. Mui, Colleen Sweeney

[1] Mt Holyoke REU, G. Davidoff Advisor

PME Session #8

Washington Room (Westin Hotel) **3:00 P.M. – 4:55 P.M.**

3:00-3:15

MATHEMATICAL BIOLOGY CURRICULUM DEVELOPMENT

Henry Gould
Hope College – Michigan Delta

Mathematical Biology is an ever-expanding field that benefits greatly from its interdisciplinary nature. At Hope College we have created a mathematical biology course co-taught to a mixed audience of biology and mathematics students. The course is based on biology research papers and includes wet labs. We will discuss the format of the class, details of the research papers and labs, student reactions, and outcomes from the course.

3:20-3:35

WATCH THE BIRDIE!

Steve Dinda
Youngstown State University – Ohio Xi

The purpose of this work is to explore two diversity indices, the Shannon-Wiener index and Simpson's index. These indices are specific sums of the proportion of each biological species observed and are commonly used by biologists to determine species diversity in ecological studies. Various properties of these sums are examined in detail. Comparing diversity indices requires a specialized *t*-test. Other more commonly used statistics are discussed and compared.

3:40-3:55

BIVARIATE NORMAL ESTIMATION OF DIGITALLY IMAGED DATA

Theodore T. Stadnik, Jr.
Youngstown State University – Ohio Xi

Bivariate normal distributions are used to estimate the form of three-dimensional data collected from a digitally captured photograph. Software is written to collect data and extract information to calculate parameters for a bivariate normal distribution with dependent variables. A regression curve is used to compute the major and minor axes of an ellipse. The software is then run to create a visual and statistical analysis of biological protein gels captured with digital imaging equipment.

4:00-4:15

A MATHEMATICAL MODEL OF TRI-TROPHIC INTERACTIONS

Michael Cortez
Hope College – Michigan Delta

While more difficult, the analysis of tri-trophic systems yields more insight than more commonly studied predator/prey models. Using non-linear differential equations, we modeled the interactions between a grass infected by a fungal endophyte, an herbivore, and a parasitoid. Analysis was conducted both experimentally and theoretically.

4:20-4:35

THE ACCURACY OF THREE-DIMENSIONAL BONE MODELS CONSTRUCTED FROM COMPUTED TOMOGRAPHY SCANS

Jill Schmidt
St. Norbert College – Wisconsin Delta

Three-dimensional models are critical when performing finite element analysis to assess stress and strain distribution in bone, particularly around an implanted prosthesis. The purpose of this study was to quantify the error of these models. Three-dimensional models of the carpal (wrist) bones created from computed tomography (CT) scans were compared to those made from laser scan data of the prepared cadaveric bones. Point cloud data were then extracted and the error was quantified. In addition, both inter-user and inter-software variability was tested. Research on this project was done with Maarten Beek and Heidi Ploeg.

4:20-4:35

MODELING CELL PROCESSES WITH MONTE CARLO SIMULATION

Rita Schneider
Fairfield University – Connecticut Gamma

Calcium is vital in many cell functions. After briefly describing calcium channel gating within the cell, we will look at how this process is modeled.

MAA Student Lectures

2004	Mario Martelli	*The Secret of Brunelleschi's Cupola*
2004	Mark Meerschaert	*Fractional Calculus with Applications*
2003	Arthur T. Benjamin	*The Art of Mental Calculation*
2003	Donna L. Beers	*What Drives Mathematics and Where is Mathematics Driving Innovation?*
2002	Colin Adams	*"Blown Away: What Knot to do When Sailing" by Sir Randolph "Skipper" Bacon III*
2002	M. Elisabeth Pate-Cornell	*Finding and Fixing Systems' Weaknesses: The Art and Science of Engineering Risk Analysis*
2001	Rhonda Hatcher	*Ranking College Football Teams*
2001	Ralph Keeney	*Building and Using Mathematical Models to Guide Decision Making*
2000	Michael O'Fallon	*Attributable Risk Estimation: A Tale of Mathematical/Statistical Modeling*
2000	Thomas Banchoff	*Interactive Geometry on the Internet*
1999	Edward G. Dunne	*Pianos and Continued Fractions*
1999	Dan Kalman	*A Square Pie for the Simpsons and Other Mathematical Diversions*
1998	Ross Honsberger	*Some Mathematical Morsels*
1998	Roger Howe	*Some New and Old Results in Euclidean Geometry*
1997	Aparna Higgins	*Demonic Graphs and Undergraduate Research*
1997	Edward Schaefer	*When is an Integer the Product of Two and Three Consecutive Integers?*
1996	Kenneth Ross	*The Mathematics of Card Shuffling*
1996	Richard Tapia	*Mathematics Education and National Concerns*
1995	David Bressoud	*Cauchy, Abel, Dirichlet and the Birth of Real Analysis*
1995	William Dunham	*Newton's (Original) Method - or - Though This Be Method, Yet There is Madness*
1994	Gail Nelson	*What is Really in the Cantor Set?*
1994	Brent Morris	*Magic Tricks, Card Shuffling and Dynamic Computer Memories*
1993	Richard Guy	*The Unity of Combinatorics*
1993	Joseph Gallian	*Touring a Torus*
1992	Peter Hilton	*Another Look at Fibonacci and Lucas Numbers*
1992	Caroline Mahoney	*Contemporary Problems in Graph Theory*
1991	Lester Lange	*Desirable Scientific Habits of Mind Learned from George Polya*

J. Suthlerland Frame Lectures

2004	Joan P. Hutchinson	*When Five Colors Suffice*
2003	Robert L. Devaney	*Chaos Games and Fractal Images*
2002	Frank Morgan	*Soap Bubbles: Open Problems*
2001	Thomas F. Banchoff	*Twice as Old, Again, and Other Found Problems*
2000	John H. Ewing	*The Mathematics of Computers*
1999	V. Frederick Rickey	*The Creation of the Calculus: Who, What, When, Where, Why*
1998	Joseph A. Gallian	*Breaking Drivers' License Codes*
1997	Philip D. Straffin, Jr.	*Excursions in the Geometry of Voting*
1996	J. Kevin Colligan	*Webs, Sieves and Money*
1995	Marjorie Senechal	*Tilings as Differential Gratings*
1994	Colin Adams	*Cheating Your Way to the Knot Merit Badge*
1993	George Andrews	*Ramanujan for Students*
1992	Underwood Dudley	*Angle Trisectors*
1991	Henry Pollack	*Some Mathematics of Baseball*
1990	Ronald L. Graham	*Combinatorics and Computers*
1989	Jean Cronin Scanlon	*Entrainment of Frequency*
1988	Doris Schattschneider	*You Too Can Tile the Conway Way*
1987	Clayton W. Dodge	*Reflections of a Problems Editor*
1986	Paul Halmos	*Problems I Cannot Solve*
1985	Ernst Snapper	*The Philosophy of Mathematics*
1984	John L. Kelley	*The Concept of Plane Area*
1983	Henry Alder	*How to Discover and Prove Theorems*
1982	Israel Halperin	*The Changing Face of Mathematics*
1981	E. P. Miles, Jr.	*The Beauties of Mathematics*
1980	Richard P. Askey	*Ramanujan and Some Extensions of the Gamma and Beta Functions*
1979	H. Jerome Keisler	*Infinitesimals: Where They Come From and What They Can Do*
1978	Herbert E. Robbins	*The Statistics of Incidents and Accidents*
1977	Ivan Niven	*Techniques of Solving Extremal Problems*
1976	H. S. M. Coxeter	*The Pappus Configuration and Its Groups*
1975	J. Sutherland Frame	*Matrix Functions: A Powerful Tool*