

Mathfest 2000
Los Angeles, CA



MAA and Pi Mu Epsilon
Student Paper Sessions
August 3 - 4, 2000

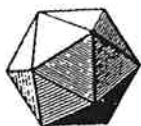


PI MU EPSILON

Pi Mu Epsilon is a national mathematics honor society with over 275 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 200 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.

J. Sutherland Frame Lecture

Friday, August 4, 2000

8:00 - 9:00 pm

Grand Horizon Ballroom, Covel Commons

THE MATHEMATICS OF COMPUTERS

John H. Ewing

American Mathematical Society

Everyone knows that computers have influenced the way we do mathematics, but many people are unaware that mathematics profoundly affects what goes on inside your computer. Mathematics – serious mathematics – underlies much of what happens everyday on your computer. This talk presents a few key examples of mathematics that are crucial to computers, explaining the way computers talk, listen, and see . . . all of which would be impossible without some sophisticated mathematics working behind the scene

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.

**Student Activities
Schedule of Events**

Wednesday, August 2

5:30 pm - 6:30 pm MAA/PME Student Reception Delta Terrace, Covel

Thursday, August 3

9:00 am - 5:00 pm	Student Hospitality Center	212 Bradley
1:00 pm - 2:35 pm	MAA Session #1	213 Bradley
1:00 pm - 2:35 pm	PME Session #1	216 Bradley
1:00 pm - 2:35 pm	MAA Session #2	215 Bradley
1:00 pm - 2:35 pm	PME Session #2	217 Bradley
3:00 pm - 4:55 pm	MAA Session #3	213 Bradley
3:00 pm - 4:35 pm	PME Session #3	216 Bradley
3:00 pm - 4:35 pm	MAA Session #4	215 Bradley
3:00 pm - 4:35 pm	PME Session #4	217 Bradley

Friday, August 4

9:00 am - 5:00 pm	Student Hospitality Center	212 Bradley
1:00 pm - 2:55 pm	MAA Session #5	213 Bradley
1:00 pm - 2:35 pm	PME Session #5	216 Bradley
1:00 pm - 2:35 pm	MAA Session #6	215 Bradley
1:00 pm - 2:35 pm	PME Session #6	217 Bradley
3:00 pm - 4:35 pm	PME Session #7	216 Bradley
3:00 pm - 4:15 pm	PME Session #8	217 Bradley
6:00 pm - 7:45 pm	PME Banquet	Study Lounge, Covel
8:00 pm - 9:00 pm	J. Sutherland Frame Lecture John H. Ewing, AMS <i>The Mathematics of Computers</i>	Grand Horizon, Covel

Saturday, August 5

9:00 am - 3:00 pm	Student Hospitality Center	212 Bradley
1:00 pm - 2:50 pm	MAA Student Workshop V. Frederick Rickey, USMA <i>Fun, Interesting, and Historical Examples of Infinite Series and Improper Integrals</i>	Salon A, Covel
3:00 pm - 3:50 pm	MAA Student Lecture Michael O'Fallon, Mayo Clinic and ASA <i>Attributable Risk Estimation: A Tale of Mathematical/Statistical Modelling</i>	Salon A, Covel
4:00 pm - 4:50 pm	Student Problem Solving Competition	Salon A, Covel
5:00 pm - 5:50 pm	MAA Modeling Contest Winners	Salon A, Covel

MAA Session #1

213 - Bradley International Center

1:00 P.M. - 2:35 P.M.

1:00 - 1:15

PREDICTABILITY OF LOUISIANA AND SOUTH CAROLINA WATERLOGGED FORESTS

Jeffrey L. Wolfe
Coastal Carolina University

Given tree diameter measurements from several dry, intermediately flooded, and completely flooded plots in Louisiana and South Carolina, the growth and mortality of such trees is determined. Forecasting the survival status of the trees within these plots is attempted using mathematical modeling.

1:20 - 1:35

TRAJECTORY ESTIMATION OF A 2.75-INCH HYDRA-70 ROCKET

H. Alex Ortiz
SUNY College at Fredonia

We will present an algorithm for computing the trajectory of a 2.75-inch rocket using onboard angular rate sensors and accelerometers. These rockets are typically launched from helicopter platforms and exhibit maximum spin rates of 35 Hz, which complicates the nonlinear system of differential equations required to model their flight.

1:40 - 1:55

ANALYZING THE FACTORIZATION OF A FOUR-TERM MULTIWAVELET TRANSFORMATION

Alison Leuthard* and Meghan O'Brien
University of St. Thomas

Image data are often integer-valued. It is desirable that any transform used to process the image maps integers to integers. In this talk, we describe a two step algorithm for scaling multiwavelet transforms so that they map integers to integers and derive the first step of the algorithm.

2:00 - 2:15

SCALING MULTIWAVELETS TO MAP INTEGERS TO INTEGERS

Alison Leuthard and Meghan O'Brien*
University of St. Thomas

In this talk, we derive the second step in a two step algorithm that describes how to scale multiwavelet transforms so that they map integers to integers. We conclude the talk with some examples of how the algorithm works and how multiwavelet integer transforms compare to other transforms in data compression.

2:20 - 2:35

SYMMETRIES OF GRAVITATIONAL FIELDS

Jamie B. Jorgensen
Utah State University

Symmetry arguments play a central role in general relativity. This talk describes a research project whose goal is to classify and characterize all possible symmetries of 4-dimensional spacetimes. The project utilizes Maple software to compute invariant tensor fields, connections, reduced Einstein equations, residual symmetries, etc., corresponding to each symmetry group.

THURSDAY

AUGUST 3, 2000

PME Session #1

216 - Bradley International Center

1:00 P.M. - 2:35 P.M.

1:00 - 1:15

WHAT DOES A 40% CHANCE OF RAIN REALLY MEAN?

Katie Fleming

Youngstown State University - Ohio Xi

Weather is around us everyday. Rain, in particular, affects many aspects of our lives. In this talk I look at the different aspects of weather and translate the percentage chance of rain into what it really means to find out if the weathermen and -women are 100% right.

1:20 - 1:35

STATISTICAL ANALYSIS OF MASTERY LEARNING

Jodie Matulja

Youngstown State University - Ohio Xi

Mastery Learning is a teaching technique that promotes student learning by letting each student rework tests to reclaim missed points. There is a considerable amount of extra grading involved for teachers who implement Mastery Learning. This project will compare information from two linear algebra classes that were taught using Mastery Learning to ascertain if it is a worthwhile classroom technique.

1:40 - 1:55

MARK MCGWIRE MEETS MATHEMATICIANS

David Gerberry

Youngstown State University - Ohio Xi

In recent seasons of major league baseball, the outburst of offense has definitely added excitement to the national pastime. However many "old school" fans have been left to wonder what happened to the days of the pitchers duel. Using statistical methods to examine the offensive trend, we can hope to shed some light on this phenomenon and its possible causes.

2:00 - 2:15

A RISKY ALGORITHM: THE RELATIVE RISK VS THE ODDS RATIO

John Slanina

Youngstown State University - Ohio Xi

In medical statistical analysis, the odds ratio is most often used to predict the risk for health outcomes given exposure to a disease. Because the odds ratio and its respective confidence intervals are easy to compute, statistical software packages such as SPSS and SAS use this indicator as their method to compute risk. In some health studies however, the incidence of disease is high and the odds ratio's estimate of risk is erroneous, sometimes by several magnitudes. This presentation will focus on creating an algorithm to calculate the correct relative risk values and its computationally challenging confidence intervals from the given statistical data.

2:20 - 2:35

VIRTUAL VISUALIZATIONS

Robert Shuttleworth

Youngstown State University - Ohio Xi

The spread of smog and other airborne contaminants is a growing problem in the world. To effectively analyze these problems, scientists create visualizations as an easy means to three-dimensionally organize and view the data in question. This presentation will showcase the mathematics behind creating these visualizations as well as how these visualizations are used in the work of both Oak Ridge National Labs (ORNL) and the Defense Intelligence Agency (DIA).

MAA Session #2

215 - Bradley International Center

1:00 P.M. - 2:35 P.M.

The presentations in this session involve students of Professor Anant Godbole in the REU Program at East Tennessee State University.

1:00 - 1:15

CORDIAL LABELINGS OF RANDOM GRAPHS

Carl Miller* and Dan Ramras

Duke University and Cornell University

A graph labeling is **cordial** if it satisfies a certain parity constraint. The existence of a cordial labeling is necessary for a well-known condition for graphs called **gracefulness**. We consider cordiality in the case of the random graphs $G(n, p)$ and $G(n, k)$.

1:20 - 1:35

PEBBLING

Dorea Claassen, Julia Salzman*, and Adam Wierman

University of Nebraska - Lincoln, Princeton University, and Carnegie Mellon University

We consider a distribution of t pebbles on n vertices with a pebbling step consisting of removing two pebbles from one vertex and placing one pebble on a neighboring vertex. A graph is **pebbleable** if each vertex can be reached in a sequence of pebbling steps. We investigate the pebbling threshold function for random graphs $G(n, p)$.

1:40 - 1:55

KAPREKAR'S CONSTANT

Sam Greenberg

Oberlin College

Consider any four-digit number. Re-order the digits in decreasing order, creating the largest value with those digits. Reverse that for the smallest value. Subtract those two arrangements and repeat the process. Eventually, one reaches the fixed point 6174. We will discuss the above phenomenon and generalizations with n digits in base b .

2:00 - 2:15

COIN FLIPPING

Julia Eaton

University of Rochester

The objective of our two player p -coin flipping game, where $P(\text{heads}) = p$, is to obtain the highest number of flips before flipping heads. A tie requires additional rounds until a winner emerges. We calculate the expected number of flips and rounds for this game and then investigate a game of n players.

2:20 - 2:35

RANDOM PERFECT MATCHINGS

Deborah E. Sinclair

University of Redlands

We consider two perfect matchings chosen at random and examine the distribution of the number of edges in the overlap. We study graphs including cycles, bipartite graphs, wheels, and the Peterson graph. We also investigate the expected number of overlaps for an n -cube and a random graph.

PME Session #2

217 - Bradley International Center

1:00 P.M. - 2:35 P.M.

1:00 - 1:15

PROPERTIES OF POSITIVE SEMI-DEFINITE OPERATORS

Anthony D. VanHoy

East Carolina University - North Carolina Delta

What is a "positive matrix?" Early in elementary education, students learn a basic definition of positive numbers. Soon after, students learn of arrays of numbers called matrices. Here I wish to combine these two concepts in an attempt to provide a comprehensive definition and some important properties of "positive matrices."

1:20 - 1:35

FRACTAL TILINGS WITH RADIAL SYMMETRY

Adam Roberts

The University of Akron - Ohio Nu

Let $m > 1$ be an integer and let $\{v_j\}_{j=1}^m$ denote the collection of two-dimensional vectors composed of the $m - 1$ roots of unity and the zero vector. Attractor sets will be generated using an iterated function system of the form

$$f_j(z) = v_j + \begin{bmatrix} \alpha & -\beta \\ \beta & \alpha \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}, \quad j = 1, 2, \dots, m$$

where $\alpha^2 + \beta^2 = 1/m$, $\alpha, \beta \in \mathbb{R}$. This talk will address the problem of determining conditions on α, β and m so that these attractors are self similar tilings possessing radial symmetry.

This work is part of a summer research program for undergraduates at the University of Akron.

1:40 - 1:55

IRREGULAR SIERPINSKI TRIANGLES

Matthew Palmer

The University of Akron - Ohio Nu

The Sierpinski triangle is a classic example of a fractal curve generated by a system of functions. First, I will show how to randomize the Sierpinski triangle with linear transformations of the form

$$f_i(\vec{x}) = M\vec{x} + \vec{\mu}_i,$$

where M is a 2×2 matrix and $i = 1, 2, 3$. This construction allows for subtriangles that are not congruent. Second, I will address conditions under which a change of basis matrix B can be found so that

$$h = BMB^{-1} = \begin{bmatrix} \alpha & -\beta \\ \beta & \alpha \end{bmatrix}.$$

This transformation h gives us the fractal dimension of the random triangle.

This work is part of a summer research program for undergraduates at the University of Akron.

2:00 - 2:15

MANIFOLDS: THEY'RE NOT JUST FOR CARS

Duane K. Farnsworth

Mount Union College - Ohio Omicron

Real manifolds form an important class of mathematical objects. Using specific examples, we will explore some basic properties of manifolds. We will also examine the boundary and the interior of a manifold. Finally we will briefly investigate differentiable real manifolds.

2:20 - 2:35

FUNDAMENTAL GROUPS AND THE MANIFOLDS IN YOUR CEREAL BOWL

Judy Maendel

Mount Union College - Ohio Omicron

What is the difference between a cocoa-puff and a fruit loop? If you answered, "One has a hole and the other does not," you are correct; however, since you are most likely a math major, you will need to have a more rigorous explanation. Find out how Fundamental Groups can help!

MAA Session #3

213 - Bradley International Center

3:00 P.M. - 4:55 P.M.

3:00 - 3:15

PSEUDO-PRIMES, CARMICHAEL, AND SIGMA-PHI NUMBERS

Kevin L. Weis
The College of New Jersey

We define a composite number $n = \prod p^{\alpha}$ as Sigma-Phi if $\sum_{p^{\alpha}|n} \varphi(p^{\alpha})$ divides $n - 1$. R. C. Vaughan has shown that there are infinitely many such numbers. Building on a result in the 1970's of Carl Pomerance and Paul Erdős, we prove, in collaboration with Pomerance, that the density of Sigma-Phi numbers is zero.

3:20 - 3:35

ENUMERATING DIFFERENCE TRIANGLES OF CARDINALITY k

William Adam Pursel
Ashland University

A $(1, k - 1)$ -difference triangle set is a set of k integers such that the differences between any two elements from the set are distinct and non-zero. Define $D(n, k)$ to be the number of $(1, k - 1)$ -difference triangle sets that are subsets of the set $\{0, 1, \dots, n\}$. This talk will present recursion and explicit formulas for calculating $D(n, 3)$ and some preliminary results for $D(n, 4)$.

3:40 - 3:55

THE DISTRIBUTION OF EUCLIDEAN PRIMES

Rasheedah Askew and Kishya Curry
Wayne State University

The study of primes generated by the technique of Euclid has a modern history going back at least to the 1880's. Using recursive number theoretic techniques, we have now computed all Euclidean primes up to 50 million and have investigated statistically their distribution among all primes.

4:00 - 4:15

EUCLIDEAN PRIMES, POLLARD RHO FACTORIZATION AND THE BIRTHDAY PROBLEM

Lakeyla Darkins and Derrick Marable
Wayne State University

Products of Euclidean primes give examples of pseudoprimes for a version of the Pollard rho factorization method. Probabilistic analysis of properties of these special primes thus gives insight into the computational complexity of this important factoring technique.

4:20 - 4:35

ON GENERALIZED SCHUR NUMBERS

Richard Hasenauer
Mesa State College

Ramsey theory and Schur numbers have recently been generalized. This presentation will be the results obtained at the REU program conducted at the University of Idaho. The results will be on generalized Schur numbers.

4:40 - 4:55

ON LUCAS' THEOREM

Lauren Mason
Miami University

How many of the entries in row 47 of Pascal's Triangle are divisible by 7? By 2? We are able to show how to answer questions like these using Lucas' Theorem. This little known result is useful when analyzing the remainders of binomial coefficients modulo a prime. In addition to applications of Lucas' Theorem in Pascal's Triangle, we will give a general discussion of the theorem and some of its consequences.

THURSDAY

AUGUST 3, 2000

PME Session #3

216 - Bradley International Center

3:00 P.M. - 4:35 P.M.

3:00 - 3:15

THE BEST SEAT IN THE HOUSE

Sarah Grove
Youngstown State University - Ohio Xi

Movies, plays and concerts are wonderful to see. The better your seat, however, the more you enjoy the experience. Noone likes to watch movies at an awkward viewing angle. Logically, the maximized viewing angle should encompass the entire screen or stage. Mathematical techniques will be presented to determine which seat is the best in the house.

3:20 - 3:35

SEPARATED AT BIRTH?

Ryan Siskind
Youngstown State University - Ohio Xi

Two equations walking down the street bump into each other. As the two equations look each other over, they don't notice much in common, but there is an eerie connection between the two. It is almost as if they are the same. Visually the two equations look very different, but they are both used to determine differentiability in multivariable calculus. I will prove that they are in fact equivalent, and explain why different definitions are given.

3:40 - 3:55

CONVERGENCE OF INFINITE SERIES

Sara LaLumia
Youngstown State University - Ohio Xi

In 1734, Leonhard Euler announced that he had found the sum of the series $1 + \frac{1}{4} + \frac{1}{9} + \dots + \frac{1}{k^2} + \dots$. This problem had baffled mathematicians for over a hundred years, and Euler's solution, $\frac{\pi^2}{6}$, was quite a surprise. Euler went on to find the sums of similar series, with k raised to different even powers. However he was unable to solve the problem with k raised to an odd power. Even today this remains an unsolved problem. I will discuss the methods used by Euler to find $\sum \frac{1}{k^2}$ and present some approximations for $\sum \frac{1}{k^3}$.

4:00 - 4:15

ROULETTE WITH A TWIST

Marie Artesse
Sonoma State University - California Nu

We will apply integral calculus to probability density in the context of a "rigged" roulette game.

4:20 - 4:35

TRIGONOMETRIC FUNCTIONS OF MATRICES

Rachael Floit
Augustana College - Illinois Eta

Beginning with a discussion of the development of both matrices and trigonometric functions, this presentation shows that by expressing trig functions as Taylor sums and Taylor series, it is possible to approximate the value of a trig function of a square matrix. It then goes on to cover the much simpler method that can be used when the matrix in question happens to be diagonalizable. The conclusion relays some special rules of trigonometric functions as they apply to matrices.

MAA Session #4

215 - Bradley International Center

3:00 P.M. - 4:35 P.M.

The first three presentations in this session involve students of Professor Anant Godbole in the REU Program at East Tennessee State University.

3:00 - 3:15

THE SPLITTING NUMBER

Adam Wierman* and Dan Ramras
Carnegie Mellon University and Cornell University

Let n points be distributed within a metric space. Define the splitting number, S_n , to be the maximum distance between any two nonempty sets that form a partition of the points. We will present results describing both properties of the sets defining the splitting number and the asymptotic behavior of S_n .

3:20 - 3:35

INDEPENDENT NEIGHBOR SETS IN RANDOM GRAPHS

Dan Ramras* and Sam Greenberg
Cornell University and Oberlin College

Let $G = (V, E)$ be any graph. For each vertex v , let $f(v)$ be the maximum size of an independent set of neighbors of v . It is known that the average value of $f(v)$ is never more than $\frac{n}{2}$. We study this average value on the random graph $G(n, p)$.

3:40 - 3:55

DISTRIBUTING UNMARKED BALLS AMONG DISTINCT BOXES

Dorea Claassen
University of Nebraska - Lincoln

Consider n unmarked balls distributed among r distinct boxes. How many boxes will contain no balls, k balls, less than or equal to k or greater than or equal to k balls? We will present a brief history of the problem and new results.

4:00 - 4:15

THE PARRONDO PARADOX

Danielle King
Tarleton State University

This presentation will use a computer simulation to demonstrate two games. Each game independently results in steady losses over time. However, when played successively in random order, the result is a steady gain. This is the crux of the Parrondo Paradox, recently discovered by Spanish physicist Juan Parrondo.

4:20 - 4:35

WHO HAS MY HAT?

Wendy L. Corp
Benedictine University

We investigate extensions of the Hatcheck Problem. We find P_{n, k_1, \dots, k_m} , ($1 \leq k_1 < \dots < k_m$), the probability that a randomly chosen element $\sigma \in S_n$ contains no k_i -cycles, $1 \leq i \leq m$. We also consider the joint distribution of the pair of statistics (number of k_1 -cycles, number of k_2 -cycles) for $\sigma \in S_n$.

THURSDAY

AUGUST 3, 2000

PME Session #4

217 - Bradley International Center

3:00 P.M. - 4:35 P.M.

3:00 - 3:15

UNDERSTANDING THE FINITE ELEMENT METHOD FOR SOLVING DIFFERENTIAL EQUATIONS

Jonathan Moussa

Worcester Polytechnic Institute - Massachusetts Alpha

Most differential equations are not analytically solvable and require numerical methods to find solutions. The Finite Element Method is a technique for converting differential equations into linear systems that are easily solvable using numerical techniques. The solutions of the linear systems lead to approximate solutions to the original differential equations whose errors are well defined and reducible. FEM is a broad field and can seem daunting, but we have broken the method down into small steps and applied it to a simple differential equation. This explanation of the Finite Element Method is meant to be understandable for anyone with a standard knowledge of calculus and linear algebra.

3:20 - 3:35

STATISTICS IN THE WORLD OF CIVIL SERVICES

Yakov Kronrod

Worcester Polytechnic Institute - Massachusetts Alpha

Statistical modeling is a powerful tool with many real world applications, such as the following: A company is looking to expand and open new community corrections centers. Using data related to existing sites, including profit and funding available, an interest index is developed, and other variables such as crime rates are regressed against it. After a process of validation, significance checking, and transformation of variables, a model is derived that predicts the interest index of a new site based on the values of the variables involved in the regression.

3:40 - 3:55

APPLICATION OF SAMPLING TECHNIQUES IN A GAMBLING SURVEY

Bethany Bray

University of Michigan at Dearborn - Michigan Zeta

This talk will center around the application of sampling techniques used in collecting gambling survey data, as well as the importance of the census related to these sampling frames. Included will be an analysis of the statistical methods and results from a gambling survey of the metropolitan Detroit area conducted in the Spring of 2000.

4:00 - 4:15

SEARCHING FOR A PERFECT VOTING SYSTEM

Joel Lepak

Youngstown State University - Ohio Xi

We have all been taught that the best way to decide things is to let everyone vote, but how fair is voting? Our voting methods all have many flaws, some of which allow election results to be altered by devious politicians. Is there a better way for society to make choices? Specific examples, including this year's London mayoral election, will be used to illustrate various flaws, and a voting system that avoids some of the major flaws will be derived.

4:20 - 4:35

THE IRRATIONALITY OF e AND π

Thomas Wakefield

Youngstown State University - Ohio Xi

In various areas of mathematics, engineering, and the physical sciences, e and π are important physical constants. Because of this, the nature of e and π interest mathematicians. The irrationality of these numbers has been verified by various methods of proof. Two such proofs are examined in this presentation.

MAA Session #5

213 - Bradley International Center

1:00 P.M. - 2:55 P.M.

The first three presentations in this session involve students of Professor Frank Morgan in the REU Program at Williams College.

1:00 - 1:15

DOUBLE BUBBLES IN NON-EUCLIDEAN SPACES

Andrew Cotton
Harvard University

The Double Bubble Conjecture has recently been proven in \mathbb{R}^3 and \mathbb{R}^4 , showing that the familiar shape of soap bubbles actually is the best way to enclose and separate two volumes. The proof uses various symmetry and instability arguments. We discuss and present our work on extending these methods to hyperbolic space \mathbb{H}^3 and the sphere S^3 .

1:20 - 1:35

CAN FRAGMENTING DOUBLE BUBBLES BE COST-EFFECTIVE?

David Freeman
Harvard University

The recent Double Bubble Theorem states that the way to enclose and separate two volumes in \mathbb{R}^3 using the least surface area is with two spheres fused together. An important part of the proof is showing that it is never more efficient to subdivide each region into smaller parts. We are working on extending these results to hyperbolic space \mathbb{H}^3 and the sphere S^3 .

1:40 - 1:55

THE ISOPERIMETRIC PROBLEM ON SINGULAR SURFACES

John Spivack
Williams College

The isoperimetric problem on a given surface seeks the curve of minimum perimeter to enclose a given quantity of surface area. On the plane, the answer is a round circle. We discuss the problem on surfaces with singularities, such as a cylindrical can or an optical lens.

2:00 - 2:15

INTRACTABILITY AND UNDECIDABILITY OF SMALL SETS OF WANG TILES

Adam DeLisse
University of Arkansas

Aperiodic tilings are a relatively new branch of mathematics. This project delves into the simplest subset of aperiodic tiles by endeavoring to fully understand small sets of Wang tiles. We search for a small aperiodic set through computer algorithms, looking at all possible tile sets along the way.

2:20 - 2:35

CONTINUOUS MOTION OF A NONSINGULAR MATRIX IN \mathbb{R}^n INTO THE IDENTITY

Rebecca Torrey and Keith McCarron
American University

Homotopically transforming a real matrix in \mathbb{R}^n to the identity while maintaining nonsingularity is an historical problem. We describe solutions involving eigen-decompositions constructed by various authors. We present an elementary solution employing at most $n-1$ planar rotations and the Gram-Schmidt orthogonalization process. Matlab movies aiding visualization will be shown.

2:40 - 2:55

STOLZ' THEOREM: L'HOPITAL'S RULE FOR SEQUENCES

Teresa Selee
Youngstown State University

Approximately 100 years ago, Otto Stolz proved an interesting theorem that says that for any two sequences a_n and b_n , such that b_n increases to infinity,

$$\lim_{n \rightarrow \infty} \frac{a_n}{b_n} = \lim_{n \rightarrow \infty} \frac{a_n - a_{n-1}}{b_n - b_{n-1}}$$

provided the limit on the right side exists or equals infinity. A brief introduction to the origin of the theorem will be given. Applications and examples will be shown to illustrate the usefulness of this simple, yet often forgotten theorem.

FRIDAY

AUGUST 4, 2000

PME Session #5

216- Bradley International Center

1:00 P.M. - 2:35 P.M.

1:00 - 1:15

ZERO SUM RADO NUMBER FOR $X_1 + X_2 + C = X_3$

Kathryn Rendall

St. Norbert College - Wisconsin Delta

Given an equation L in t variables, the zero sum Rado number for L is the least integer n such that for every n -coloring Δ there exists a zero sum solution to L . For the solution to be zero sum, the sum of the colors must be divisible by t . In this talk we will present the zero sum Rado number for the equation $X_1 + X_2 + C = X_3$. The results that are presented were found as part of the REU at the University of Idaho in Moscow, Idaho, during the summer of 1999.

1:20 - 1:35

INVESTIGATING THE IRREGULARITY STRENGTH OF TREES

David Kravitz

University of Delaware - Delaware Alpha

The irregularity strength of a graph has recently become of interest to both number theorists and graph theorists. Here we deal with a specific conjecture relating to the irregularity strength of trees, which claims that the strength is essentially either the number of vertices of degree 1 or the average of the number of vertices of degree 1 and degree 2. After making the audience familiar with the necessary vocabulary in graph theory and defining irregularity strength, we present a brief survey of known results. Then we describe how we tried to prove the conjecture and how this led to an infinite series of counterexamples to refute it.

1:40 - 1:55

FINITE DIVISION RINGS ARE FIELDS

Todd Horne

Hunter College - New York Beta

If a division ring is finite then its multiplication must be commutative. An outline of a wonderful proof of this fact, which weaves pieces of ring theory, group theory, linear algebra, number theory and complex analysis into a contradiction, will be presented.

2:00 - 2:15

SYMMETRIC EXPONENTIAL EQUATIONS

David Kurzynski

St. Norbert College - Wisconsin Delta

Given a positive number a , does there exist a different positive number b such that $a^b = b^a$? We discuss solutions to this equation and to some generalized versions.

2:20 - 2:35

ENERGIZER FRACTIONS: THEY KEEP GOING AND GOING AND ...

Erin M. Bergman

St. Norbert College - Wisconsin Delta

We will introduce the topic of continued fractions and some techniques for evaluating them. A variety of examples and some elementary properties will also be discussed. In addition we will present the exact representations of some irrational numbers (including square roots) as well as the estimated representations of others (such as π).

MAA Session #6

215 - Bradley International Center

1:00 P. M. - 2:35 P.M.

1:00 - 1:15

MALL TIME!

Irma M. E. T. Servatius
Massachusetts Academy of Mathematics and Science

Assuming a uniform maximum speed, all points that can be reached within an hour from a given point (the mall) lie on a circle. If the uniformity is destroyed by, for example, a single road on which one can travel faster, the circle is deformed. We investigate the new shape obtained depending on the distance of the road to the mall and generalize the problem.

1:20 - 1:35

STRAIGHT LAUNCH

Danielle Delimata
St. Norbert College

Suppose a toy race car runs down a ramp that is fixed with a pivot in the middle. If the car is allowed to fall to the floor, the horizontal distance from the pivot point depends on the angle of the ramp. We will investigate this relationship and determine what angle maximizes the distance.

1:40 - 1:55

INTERCEPTING AN OBJECT USING THE SLOWEST SPEED

Kevin G. Santry
St. Norbert College

Suppose object A , which is traveling on a known parametrized curve, is to be intercepted by object B . Object B will be starting at the origin and traveling in a straight line at a constant speed. We will discuss how to determine the slowest possible speed for object B that will allow for this interception.

2:00 - 2:15

ABSTRACTIONS FROM THE WORK OF ARCHIMEDES

Dee Anna Rendall
Carthage College

The Sand-Reckoner, by Gillian Bradshaw, is a fictional account of the life of Archimedes and includes a description of some of his works. We will use this book as the basis for a discussion of some of Archimedes' achievements and the context in which they occurred.

2:20 - 2:35

GAME THEORY

Erika Faires
Westminster College

This project first examines several different kinds of two-player games. Some terminology introduced includes the idea of a kernel, strategies for winning, and configurations that make such an outcome favorable. Next, the project explores the two-player game of Nim and extensions of this game to include more players.

FRIDAY

AUGUST 4, 2000

PME Session #6

217 - Bradley International Center

1:00 P.M. - 2:35 P.M.

1:00 - 1:15

POLLUTION DISPERSION IN LARGE INDOOR PLACES

Jeffrey Housman

Sonoma State University - California Nu

We have created a computational model of pollution dispersion in a large complex room. The model consists of solving the incompressible Navier-Stokes equations within a complex room geometry (7.0m × 9.2m × 11.0m) with a ventilation system, and releasing a tracer gas from the floor. With the model we gain deeper understanding of the dynamics of a pollutant indoors, specifically its behavior within the first 5 - 20 minutes after initial release. This presentation will show the results of pollutant dispersion for isothermal wall boundary conditions and discuss some applications of these results.

1:20 - 1:35

PRICING THE AMERICAN CALL OPTION

Michelle Swenson

University of Nebraska at Lincoln - Nebraska Alpha

Many financial models used on Wall Street depend on the Black-Scholes formula for European options. To find a similar formula for American options, we transform the original PDE into an integral equation using Fourier transforms. A crucial difference for American options is the existence of a free boundary, which we explain.

1:40 - 1:55

AN INTRODUCTION TO TRAFFIC FLOW

Lori McMenamin

University of Michigan at Dearborn - Michigan Zeta

In this talk I will examine some of the effects of a red light on traffic flow. Specifically, I will consider a mathematical model of traffic flow before, during and after a red light. My talk will also include a discussion of the nonlinear partial differential equations and shock waves that arise in the modeling of traffic flow.

2:00 - 2:15

RSA CIPHER SYSTEM: WHAT IS IT AND WHY IS IT SO SAFE?

Hai He

Hunter College - New York Beta

2:20 - 2:35

BRAESS' PARADOX IN COMPUTER NETWORKS

Abhiram Shandilya

Angelo State University - Texas Zeta

Braess' Paradox asserts that reducing the number of pathways in a transportation network may actually improve traffic flow. In my presentation I shall present the results of my own research on the paradox in the context of computer networks.

The abstract for the following paper was accidentally omitted from the program:

PME Session #6

2:00 - 2:15

RSA Cipher System: What is it and Why is it so safe?

Hai He

Hunter College - New York Beta

Since its inception in the mid-1970s, the RSA cipher system has provided one of the safest channels for transferring of information. But what is the RSA cipher system, how does it work, and most importantly, how come it is so safe?

PME Session #7

216 - Bradley International Center

3:00 P.M. - 4:35 P.M.

3:00 - 3:15

WOMEN IN THE HISTORY OF MATHEMATICS

Elizabeth Evans

University of South Carolina - South Carolina Alpha

This talk presents a series of six vignettes that trace some of the consequential contributions made by prominent women mathematicians. It includes a brief outline of their education, unique struggles and most significant achievements in the field of higher mathematics.

3:20 - 3:35

FIGURE IT OUT: THE MATHEMATICS BEHIND FIGURE SKATING SCORES

Abby Mroczenski

St. Norbert College - Wisconsin Delta

Many of us have watched figure skating at the Winter Olympics and have seen the scores that the judges give the skaters. What do these numbers mean? What really determines the placement of the skaters, and why was such a complicated system devised?

3:40 - 3:55

RADIAL CHECKERS: A NEW TWIST TO AN OLD GAME

Heather A. Olm

St. Norbert College - Wisconsin Delta

The game of checkers is played on a square board partitioned into eight rows and eight columns. We will examine several different possibilities for checker boards and investigate their mathematical properties.

4:00 - 4:15

SAM LOYD'S FIFTEEN PUZZLE: THE EVEN, THE ODD AND THE SOLVABLE

Stacy A. May

Southern Illinois University at Edwardsville - Illinois Zeta

The original Fifteen Puzzle introduced by Sam Loyd is unsolvable because a solution would violate the even/odd principle. It is known that a solution exists if the configuration does satisfy the even/odd principle, however no rigorous proof of this fact seems to be commonly known. We will describe the puzzle, explain the even/odd principle, and present a proof based on the recent work of Aaron Archer.

4:20 - 4:35

FUN WITH FLEXAGONS

Jeffrey Dumont

Lafayette College - Pennsylvania Tau

Created by some Princeton students in the early twentieth century, flexagons are fascinating little paper creations which exhibit unexpected symmetry. We will discuss how to create different tetra- and hexa-flexagons as well as determining the symmetry of these paper creations.

FRIDAY

AUGUST 4, 2000

PME Session #8

217 - Bradley International Center

3:00 P.M. - 4:15 P.M.

3:00 - 3:15

WHICH IS THE RIGHT PATH FOR ME?

Rosemary Tornase

St. Norbert College - Wisconsin Delta

Every calculus student is familiar with the problem of finding the quickest route from point A to point B where the possible routes involve differing speeds. We will present a variety of solutions to a generalization of this problem.

3:20 - 3:35

CONTINUITY OF THE DERIVATIVE AT A POINT AND ON AN INTERVAL

John T. Griesmer

Miami University - Ohio Delta

When calculus is applied to other areas of study, the derivative of a real-valued function of a real variable is often assumed to be continuous. A simple example shows that even when the derivative of a function exists everywhere on an interval, the derivative may be discontinuous at a point. In this paper we construct some pathological examples and characterize continuity of the derivative by reformulating the standard definition of derivative; we also prove further results using this definition.

3:40 - 3:55

AN ADAPTATION OF THE IMPROVED EULER'S METHOD
FOR 2-DIMENSIONAL HAMILTONIAN SYSTEMS

Dzuan K. Nguyen

University of Nebraska at Lincoln - Nebraska Alpha

Hamiltonian systems have several special properties not shared by general systems of differential equations. When the Improved Euler's Method is applied to find numerical solutions of Hamiltonian systems, this special property is not used. We modify the Improved Euler's Method for such systems and show it has better numerical solutions.

4:00 - 4:15

THE SI REALIZATION OF FORCES AT THE NANO-NEWTON LEVEL

Laura A. Feeney

Miami University - Ohio Delta

In industry there exists a need for a technique that allows small forces in the nano-Newton range to be accurately measured. Such a technique would provide the means for calibrating machines that employ these forces very precisely, e.g., micro-electromechanical systems (MEMS), atomic force microscopes (AFM) and nano-indenters. As the use of nanotechnology grows, it is becoming increasingly important to have a standard linked to the International System of Units (SI) for these small forces.

We have designed and assembled a preliminary electromechanical balance that will be used to work towards the goal of the realization of the nano-Newton. We will describe this balance and give some of its practical realizations.

MAA Student Lectures

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|------|------------------|--|
| 2000 | Michael O'Fallon | <i>Attributable Risk Estimation:
A Tale of Mathematical/Statistical Modeling</i> |
| 2000 | Thomas Banchoff | <i>Interactive Geometry on the Internet</i> |
| 1999 | Edward G. Dunne | <i>Pianos and Continued Fractions</i> |
| 1999 | Dan Kalman | <i>A Square Pie for the Simpsons
and Other Mathematical Diversions</i> |
| 1998 | Ross Honsberger | <i>Some Mathematical Morsels</i> |
| 1998 | Roger Howe | <i>Some New and Old Results in Euclidean Geometry</i> |
| 1997 | Aparna Higgins | <i>Demonic Graphs and Undergraduate Research</i> |
| 1997 | Edward Schaefer | <i>When is an Integer the Product
of Two and Three Consecutive Integers?</i> |
| 1996 | Kenneth Ross | <i>The Mathematics of Card Shuffling</i> |
| 1996 | Richard Tapia | <i>Mathematics Education and National Concerns</i> |
| 1995 | David Bressoud | <i>Cauchy, Abel, Dirichlet and the Birth of Real Analysis</i> |
| 1995 | William Dunham | <i>Newton's (Original) Method - or - Though This
Be Method, Yet There is Madness</i> |
| 1994 | Gail Nelson | <i>What is Really in the Cantor Set?</i> |
| 1994 | Brent Morris | <i>Magic Tricks, Card Shuffling
and Dynamic Computer Memories</i> |
| 1993 | Richard Guy | <i>The Unity of Combinatorics</i> |
| 1993 | Joseph Gallian | <i>Touring a Torus</i> |
| 1992 | Peter Hilton | <i>Another Look at Fibonacci and Lucas Numbers</i> |
| 1992 | Caroline Mahoney | <i>Contemporary Problems in Graph Theory</i> |
| 1991 | Lester Lange | <i>Desirable Scientific Habits of Mind
Learned from George Polya</i> |

J. Sutherland Frame Lectures

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

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