Pi Mu Epsilon

Pi Mu Epsilon is a national mathematics honor society with 329 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. 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. Pi Mu Epsilon encourages scholarly activity in it chapters with grants to support mathematics contests and regional meetings established by the chapters and through its Lectureship program that funds Councillors to visit chapters. Since 1952, Pi Mu Epsilon has been holding its annual National Meeting with sessions for student papers 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.” Currently there are approximately 550 Student Chapters on college and university campuses nationwide.

Schedule of Student Activities

Except where noted, events are at the Monona Terrace

Wednesday, July 30

2:45 pm - 4:00 pm	CUSAC Meeting	Conference II, Concourse Hotel
4:30 pm - 5:30 pm	MAA/PME Student Reception	Senate Rooms AB, Concourse Hotel
5:30 pm - 6:45 pm	Math Jeopardy	Wisconsin Ballroom, Concourse Hotel

Thursday, July 31

8:30 am - 11:30 am	PME Council Meeting	TBA
8:30 am - 10:25 am	MAA Session #1	Meeting Room L
8:30 am - 10:25 am	MAA Session #2	Meeting Room M
8:30 am - 10:25 am	MAA Session #3	Meeting Room N
8:30 am - 10:25 am	MAA Session #4	Meeting Room Q
8:30 am - 10:25 am	MAA Session #5	Meeting Room R
9:00 am - 5:00 pm	Student Hospitality Center	Exhibit Hall B
1:00 pm - 1:50 pm	MAA Lecture for Students	Ballroom A
2:00 pm - 4:00 pm	Invited Paper Session	Hall Ideas H
2:00 pm - 3:55 pm	PME Session #1	Meeting Room L
2:00 pm - 3:55 pm	PME Session #2	Meeting Room M
2:00 pm - 3:55 pm	MAA Session #6	Meeting Room N
2:00 pm - 3:55 pm	MAA Session #7	Meeting Room Q
2:00 pm - 3:55 pm	MAA Session #8	Meeting Room R
4:20 pm - 6:15 pm	PME Session #3	Meeting Room L
4:20 pm - 6:15 pm	PME Session #4	Meeting Room M
4:20 pm - 6:15 pm	MAA Session #9	Meeting Room N
4:20 pm - 6:15 pm	MAA Session #10	Meeting Room Q
4:20 pm - 6:15 pm	MAA Session #11	Meeting Room R

Friday, August 1

8:30 am - 10:25 am	MAA Session #12	Meeting Room L
8:30 am - 10:25 am	MAA Session #13	Meeting Room M
8:30 am - 10:25 am	MAA Session #14	Meeting Room N
8:30 am - 10:25 am	MAA Session #15	Meeting Room Q
8:30 am - 10:25 am	MAA Session #16	Meeting Room R
9:00 am - 5:00 pm	Student Hospitality Center	Exhibit Hall B
1:00 pm - 1:50 pm	MAA Student Activities Session: What is the Color of My Hat?	Ballroom A
1:00 pm - 1:50 pm	MAA Student Activities Session: Mathematics in Forensics	Ballroom B
2:00 pm - 4:55 pm	PME Session #5	Meeting Room L
2:00 pm - 4:55 pm	PME Session #6	Meeting Room M
2:00 pm - 4:55 pm	PME Session #7	Meeting Room N
2:00 pm - 4:55 pm	MAA Session #17	Meeting Room Q
2:00 pm - 4:55 pm	MAA Session #18	Meeting Room R
6:00 pm - 7:45 pm	PME Banquet and Awards Ceremony	Grand Terrace
8:00 pm - 8:50 pm	J. Sutherland Frame Lecture	Ballroom AB
9:00 pm - 10:00 pm	MAA Ice Cream Social and Awards	Grand Terrace

Saturday, August 2

9:00 am - 2:00 pm	Student Hospitality Center	Exhibit Hall B
9:00 am - 10:30 am	MAA Modeling (MCM) Winners	Hall Ideas E
9:30 am - 10:30 am	Math Horizons - Meet the Editors	Lecture Hall
2:30 pm - 3:45 pm	Student Problem Solving Competition	Ballroom A

J. Sutherland Frame Lecture

THE SYMMETRIES OF THINGS

John H. Conway
Princeton University

"Thurston's Commandment," namely that *"Thou shalt not understand the symmetries of a geometrical object save by studying its orbifold"* was first used (in fact before Thurston) by Murray MacBeath to enumerate the distinct finite symmetry groups that are possible for objects in space of a most three dimensions (which had been enumerated in another way by Fedorov in the 19th century). The first part of the lecture will describe the resulting groups in terms of a notation I devised some time ago, that also applies to the celebrated 17 crystallographic plane groups. The second part will describe their 3-dimensional analogs, the 219 crystallographic space groups, which were re-enumerated recently by a new method due to Conway, Delgado-Friedrichs, Huson and Thurston. It's all easy, and there will be lots of pictures!

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 Lecture for Students

SUDOKU: QUESTIONS, VARIATIONS AND RESEARCH

Laura Taalman
James Madison University

Sudoku puzzles and their variants are linked to many mathematical problems involving combinatorics, Latin squares, magic squares, polyominos, symmetries, computer algorithms, the rook problem, graph colorings, and permutation groups theory. In this talk we will explore variations of Sudoku and the many open problems and new results in this new field of recreational mathematics. Many of the problems we will discuss are suitable for undergraduate research projects. Puzzle handouts will be available for all to enjoy!

MAA Student Speakers

Name	School	MAA Session
Matt Alexander	Youngstown State University	2
Elijah Allen	Armstrong Atlantic State University	11
Candace Andrews	University of Texas at Tyler	18
Elizabeth Arango	Montclair State University	11
Dylan Asmar	United States Air Force Academy	17
Marius Balla	Gainesville State College	17
Emily Bargar	University of Chicago	9
Nicole Beauchamp	Eastern Connecticut State University	12
Kristin Bertram	Winona State University	10
Ariel Binder	Williams College	3
Robert James Booth	Rowan University	5
Sarah Boyenger	Salem College	16
James Brantner	Erskine College	13
Greg Brockman	Harvard University	6
Kristopher Bunker	Michigan Technological University	17
Albert Bush	Southern Polytechnic State University	6
Gabriel Caceres	Augustana College	5
Hunan Chaudhry	Benedictine University	14
Leslie Cheteyan	Montclair State University	8
Ashley Ciesla	Montclair State University	8
Evan Cobb	Saint Louis University	13
James Andrew Costa	UC Berkeley	14
William Davis	University of Illinois at Urbana-Champaign	1
Matthew Glenn Dawson	Union University	4
Hansheng Diao	Massachusetts Institute of Technology	5
Daniel DiPasquale	Fordham University	7
Chu Yue (Stella) Dong	Polytechnic University	1
Geoffrey Ehrman	University of Akron	1
Katie Evans	St. Olaf College	6
Andrew Fabian	Rowan University	16
Zhou Fan	Harvard College	1
Leah Fehr	Bethany Lutheran College	3
Richard Andrew Fields	Saint Louis University	13
Ernesto Garcia	University of Texas at Arlington	17
Joshua Garland	Mesa State College	4
Samantha Goeben	St. Norbert College	2
Thomas Grimes	Augustana College	4
Zhishan Guo	Saint John’s University	10
Deena Hannoun	James Madison University	3
Jodi Haponski	Clarion University of Pennsylvania	13
Vivian Healey	University of Notre Dame	9

MAA Student Speakers (Continued)

Name	School	MAA Session
Taylor Hines	Arizona State University	6
Katrina Housholder	Simpson College	10
Rachel Hudson	Williams College	14
Rachel Hunter	Cornell University	9
Andrew Johnson	Mount Union College	4
Jared Drew Johnson	Brigham Young University	16
Amol Kapila	Brown University	8
Ed Karasiewicz	Lafayette College	18
Matthew Kassel	Michigan Technological University	17
Matthew Holland Katz	Juniata College	9
Bill Kay	University of South Carolina	9
Laura Kazanjian	Emmanuel College	8
Patrick Kelley	Lafayette College	18
Colin Klaus	Vanderbilt University	3
Scott Duke Kominers	Harvard University	18
Karol Koziol	New York University	18
Joshua Langford	University of Texas at Tyler	18
Brian Leary	Carnegie Mellon University	3
Sherrita Lynnae Lee	Alabama State University	3
Jessica Lin	New York University	1
Tova Lindberg	Bethany Lutheran College	7
Michelle Lingscheit	Simpson College	13
Carolina Veronica Liskey	University of Texas at Arlington	17
Jamie Long	Moravian College	1
Antonio Lopez	University of Texas at Arlington	15
Mark Christopher Lucas	Roanoke College	1
Clara Ellen Madsen	College of Idaho	16
Emily Marshall	Dartmouth College	15
Katie Leigh McCarthy	Mount Union College	2
Tom McCollum	Michigan State University	6
Daniel Moeller	University of Notre Dame	17
Josh Mollner	University of Notre Dame	18
David Montague	University of Michigan	15
Ralph Morrison	Williams College	14
Haggai M. Nuchi	Carleton College	5
Chad Onstot	Simpson College	10
Joshua O’Rourke	Reed College	3
Chanda-Louise Oton	CUNY Hunter College	13
Gabrielle Paoletti	Canisius College	9
Geoff Patterson	Grand Valley State University	15
Yisha Peng	Zhejiang University	12
Megan Placko	Winona State University	11

MAA Student Speakers (Continued)

Name	School	MAA Session
Crystal Red Eagle	University of Texas at Arlington	17
Richelle Reed	Manchester College	12
Gina Marie Richard	Goshen College	10
Nicole Riveness	Winona State University	11
Samuel Rivera	University of Texas at Arlington	17
Eric John Robinson	United States Air Force Academy	18
Kiersten Ruff	Simpson College	13
April Russell	Grand Valley State University	2
Stephanie Sapp	Johns Hopkins University	12
Amanda Schaeffer	University of Arizona	9
Kristin Kim Schmidtke	Michigan Technological University	17
Bradley Richard Schorer	Linfield College	17
Aaron Shatzer	Luther College	5
Carson Paul Sievert	Saint John’s University	10
Elena Georgiana Simion	South Dakota State University	7
Brooks Smith	University of Notre Dame	5
Emma Snively	Rose-Hulman Institute Of Technology	9
Luke Stannard	University of Alabama at Birmingham	3
Laura Starkson	Harvard University	14
Corey Staten	Ohio State University	1
Xuyang Tang	College of St. Benedict	8
Charles Tannouri	Johns Hopkins University/Towson University	10
Peter Craig Thayer	University of Louisiana at Lafayette	7
Meredith Thornton	Lipscomb University	15
Rory Martin Tiedemann	Mount Union College	12
Olga Turanova	Barnard College	14
Stephanie Uhl	Brigham Young University	16
Rytis Umbrasas	Lafayette College	1
Anthony David Varey	Winona State University	11
Molly J. Visscher	Earlham College	15
Emily Wagoner	Simpson College	10
Kaleb Waite	Rockhurst University	12
Jeremy Ward	Simpson College	13
Ashley Weatherwax	University of Texas at Dallas	4
Eric Werley	West Chester University of Pennsylvania	5
Amy Wesolowski	College of the Atlantic	7
Michelle Westrick	Saginaw Valley State University	16
Emma Whitten	University of Notre Dame	4
Jeffery Willert	The College of Wooster	7
Sandi Xhumari	Grand Valley State University	13
Andrew Yip	Lewis and Clark College	9
Jason Yoder	Goshen College	10
Kristin Michelle Zaiki	Saginaw Valley State University	16
Jeffery Vincent Zylinski	Michigan Technological University	18

Pi Mu Epsilon Delegates

Speakers

Name	School	Chapter	PME Session
Heather Akerson	College of Saint Benedict	MN Delta	2
Meghann Barger	Western Oregon University	OR Delta	4
Samuel Behrend	Denison University	OH Iota	7
Alicia Brinkman	Saint Norbert College	WI Delta	1
Ashley Burt	Pepperdine University	CA Xi	1
Shawn Case	Fitchburg State College	MA Eta	4
William Cousins	Pepperdine University	CA Xi	1
Kristin Creech	University of Texas at Arlington	TX Iota	7
Erica Cross	Youngstown State University	OH Xi	3
Jennifer Crounse	Fitchburg State College	MA Eta	3
Abdulmajed Dakkak	University of Toledo	OH Gamma	4
Tyler Drombosky	Youngstown State University	OH Xi	1
Krista Foster	Youngstown State University	OH Xi	4
Iordan Ganev	Miami University	OH Delta	5
Yair Goldberg	The University of NC at Greensboro	NC Epsilon	6
Brent Hancock	Pepperdine University	CA Xi	1
Damon Haught	Youngstown State University	OH Xi	6
Lisa Hickok	University of IL at Urbana-Champaign	IL Alpha	5
John Hoffman	Youngstown State University	OH Xi	6
Adam Hughes	University of IL at Urbana-Champaign	IL Alpha	6
Sara Jensen	Carthage College	WI Epsilon	5
Bill Kay	University of South Carolina	SC Alpha	5
Brendan Kelly	The College of New Jersey	NJ Theta	5
Kevin Kreighbaum	Mount Union College	OH Omicron	5
Arielle Leitner	California State University, Chico	CA Omicron	5
Daniel Lithio	Hope College	MI Delta	1
William Ryan Livingston	Youngstown State University	OH Xi	6
Jim Manning	The University of South Carolina	SC Alpha	4
Cheyne Miller	Iona College	NY Psi	7
Kathleen Miller	Saint Norbert College	WI Delta	2
Daniel Monfre	Carthage College	WI Epsilon	3
Vincent Martinez	The College of New Jersey	NJ Theta	2
David Nassar	University of Akron	OH Nu	2
Peter Olszewski	Fairfield University	CT Gamma	5
Ryan Pavlik	Saint Norbert College	WI Delta	7
Jared Ruiz	Youngstown State University	OH Xi	6
Diana Saly	University of New Hampshire	NH Alpha	2
Stephanie Schauer	Saint Norbert College	WI Delta	3
Douglas Smith	Miami University	OH Delta	6

Pi Mu Epsilon Delegates (Continued)

Name	School	Chapter	PME Session
Nathan St. John	Miami University	OH Delta	5
Shira Stav	University of NC at Charlotte	NC Theta	4
Samuel Taylor	The College of New Jersey	NJ Theta	7
Kristal Temple	Western Oregon University	OR Delta	7
Jeremy Thompson	United States Air Force Academy	CO Gamma	6
Seena Vali	Fordham University	NY Alpha Nu	3
Corey Vorland	Saint Norbert College	WI Delta	2
Doug Wajda	Youngstown State University	OH Xi	7
Allison Wiland	Youngstown State University	OH Xi	7
Moriah Wright	Youngstown State University	OH Xi	6

Additional Delegates

Name	School	Chapter
Erin Parks	State University of New York at Fredonia	NY Pi

MAA Session #1

Meeting Room L **8:30A.M. – 10:25A.M.**

8:30–8:45

Episodic Cellular Automata

Chu Yue (Stella) Dong *
Polytechnic University

Cellular Automata have been used to model many physical phenomena yet there are relatively few models that exhibit complex self organizing behavior. For example, a system modeling the interaction of multiple populations where episodes of rising and falling communities are expected should exhibit complex behavior. We will examine instances of self-organizing automata exhibiting episodic behavior.

*Joint work with: Jamie Long, Corey Staten, and Rytis Umbrasas, (*Moravian College, Ohio State University, and Lafayette College*)

8:50–9:05

Measurable Sensitivity and Chaotic Dynamical Systems

Jessica Lin
New York University

Sensitive dependence on initial conditions, typically a topological notion, is one of the most common characterizations of a chaotic dynamical system. In 2006, the SMALL Ergodic Theory Group at Williams College introduced measurable sensitivity, a measure-theoretic notion of sensitive dependence on initial conditions. We extend this work by studying measurable sensitivity and its relation to other dynamical properties, such as Lyapunov exponents. This talk is based on work done by the 2008 SMALL Ergodic Theory Group.

9:10–9:25

On notions of measurable and topological sensitivity and their relation to entropy

Zhou Fan
Harvard College

Several notions of measurable sensitivity have been developed as measure-theoretic versions of sensitive dependence. We introduce new measure-theoretic and topological notions of sensitivity and characterize their relationship with existing notions. We then relate these notions of sensitivity to entropy and other dynamical properties. This talk is based on research conducted by the 2008 SMALL REU ergodic theory group at Williams College.

9:30–9:45

IlliSol: A Modern Orrery

William Davis
University of Illinois at Urbana-Champaign

IlliSol, a Real-Time Interactive Computer Animation (RTICA), is an effort to create a contemporary orrery in the immersive virtual environments of the CUBE and the CAVE at the University of Illinois. The motion of the planets and their moons around the sun is described by a set of equations, culminating in an iterated method of solving Kepler's Equation. Orrery visitors can interactively alter the properties of their environment, including the speed at which time advances as well as the size of the major planets and Sol, to present visitors with a relatively accurate real-life scenario of astronomical proportions founded upon celestial mathematics.

9:50–10:05

Interactive Visualization of Quasicrystals in Virtual Environments

Geoffrey Ehrman

University of Akron

Packing space aperiodically with Penrose rhombohedra projected from selected 3-cells in a 6D cubic lattice produces quasicrystals. These have crystallographically forbidden icosahedral symmetry; metallurgists have created such structures in the lab sparking profound interest. Collaborating with NY artist Tony Robbin we created a real-time interactive program illustrating the underlying geometry.

10:10–10:25

The Evolution of Swarm Intelligence

Mark Christopher Lucas

Roanoke College

Swarm Intelligence, along with Particle Swarm Optimization, is a robust algorithm for optimizing or solving complex, multidimensional problems that developed directly from Evolutionary and Genetic Algorithms. The basic premise is that a solution space is populated with simple bots that move and interact in very rudimentary ways. But by simple communication, a complex group intelligence emerges that focuses on the optimum solution within the space. In this talk we will explore both the history of algorithms of this sort as well as uses of Swarm Intelligence in particular. Problems that have been solved using this approach will be examined.

MAA Session #2

Meeting Room M **8:30A.M. – 10:25A.M.**

8:30–8:45

Teaching Math with Pokemon

Samantha Goeben
St. Norbert College

Children are living in a media-centered world and teachers are on a constant search for relevant and interesting techniques. One such technique uses a website titled "Pokmon Learning League". It is an interactive, narrative-based website that uses the well-known cartoons to help teach mathematics to elementary students. Research has shown that this instructional strategy increases the attitude and aptitude in both individual and group case studies, regardless of opinion towards math or Pokmon.

8:50–9:05

The Golden Ratio: Beauty in Mathematics

Katie Leigh McCarthy
Mount Union College

This talk will guide you through the golden ratio, the golden rectangle, and the golden triangle. It will show the importance of the golden ratio, where it came from, and how it is intertwined throughout nature, music, art, and life.

9:10–9:25

Cracking the Sudoku

Matt Alexander
Youngstown State University

Sudoku puzzles can be created by a program by using the same logical processes needed to solve them. By knowing how many times it is necessary to used each method we can rate the puzzle's difficulty. All puzzles created using this method will be unique and solvable using logic.

9:30–9:45

The Puzzling Mathematics of Sudoku

April Russell
Grand Valley State University

Sudoku is the latest craze in puzzles, and is played by entering digits from 1 to 9 to complete a partially filled grid so that each digit appears exactly once in each row, column, and subgrid. There are numerous variations with additional restrictions, for example, Sudoku X, where the entries on each of the main diagonals are also distinct. We present the results of our research of Sudoku variations, using permutations, rook polynomials, and equivalence relations.

MAA Session #3

Meeting Room N **8:30A.M. – 10:25A.M.**

8:30–8:45

A three-stage model of Mosquitofish population dynamics

Luke Stannard

University of Alabama at Birmingham

The research goal is to study a three stage difference equation model of a population of mosquitofish. The three stage model tracks adults (A), juveniles (J), and fry (F) populations over time via $A_t = sA_{t-1} + mJ_{t-1}$, $J_t = ge^{-kA_{t-1}}F_{t-1}$, and $F_t = fA_{t-1}$. The five parameters are: adult survival (s), juvenile survivial (m), fry survival (g), cannibalism (k), and fecundity (f). The three stage model will be investigated analytically and numerically. Later, data from current experiments will allow the model to be parameterized. The mosquitofish population will be manipulated experimentally and the resulting bifurcations checked against predicted bifurcations.

8:50–9:05

An Optimal Energy Allocation Strategy for Multiple Constrained Resources

Deena Hannoun

James Madison University

We use difference equations to model a population with overlapping generations that invests energy into finding two resources essential for its survival: food and shelter. This population is divided into two competing subpopulations that have different energy allocation strategies for a limited amount of available resources in the environment. The goal of this project is to discover how a subpopulation can divide its energy most effectively between searching for food and searching for shelter such that it can have more reproductive success than its competitor and can consequently dominate its niche.

9:10–9:25

Mathematical Model of HPV and its Impact on Cervical Cancer

Sherrita Lynnae Lee

Alabama State University

Objective: To evaluate the impact of Human Papillomavirus(HPV) on a given population and determine what can decrease the rate in which American women become infected. Design: A mathematical model of the cycle of HPV was made showing the routes individuals may choose one they become infected: treatment or no treatment. Based on their decisions, they can either increase or decrease the chance of them progressing to the stage of cervical cancer.

9:30–9:45

QTL Mapping in an Outcross in Sticklebacks

Leah Fehr

Bethany Lutheran College

Different species of Stickleback fish, from different environments, often show morphological differences. Such quantitative phenotypes are generally affected by multiple genetic loci (called quantitative trait loci, QTL). We seek to map the QTL contributing to two phenotypes, body size and number of lateral plates, in a complex outcross derived from two different Stickleback species. We hope that the joint analysis of a set of four families derived from the two founder fish, rather than individually, will give greater power to detect QTL and will provide improved estimates of the effects and locations of the QTL.

9:50–10:05

Directed graphs and groupoids

Brian Leary *
Carnegie Mellon University

Given a directed graph, it is known that one can associate to it a certain (topological) groupoid. As a next step, one investigates the relationships between various groupoid operations (product, sum, subgroupoid, induced groupoid, etc.) and manipulations at the graph level. While some results are already known, there are still cases where the knowledge is limited (like the notion of the zig-zag product of graphs). The talk will report on any progress made in enriching the relationship, using several examples. (*) This talk will present results from this summer's investigations at the Canisius College REU, Geometry and Physics on Graphs.

*Joint work with: Colin Klaus, *Vanderbilt University*

10:10–10:25

Random Walks and Geometry of Directed Graphs

Ariel Binder *
Williams College

Any locally finite directed graph determines a random walk, determined by a Markov chain. We apply techniques from algebraic graph theory to the study of interesting graphs coming from group theory and geometry. (*) This talk will present results from this summer's investigations at the Canisius College REU, Geometry and Physics on Graphs.

*Joint work with: Joshua O'Rourke, *Reed College*

MAA Session #4

Meeting Room Q **8:30A.M. – 10:25A.M.**

8:30–8:45

p-adic Numbers

Joshua Garland
Mesa State College

An algebraic introduction to the p-adic number system introduced by Kurt Hensel at the turn of the 20th century. Hensel′s p -adics are now widely used in many fields such as analysis, physics and computer science. I will give an algebraic definition of this number system and aim to utilize this definition as a tool in understanding several topological and analytic properties.

8:50–9:05

An Elementary Proof and Extension of Cauchys Theorem

Thomas Grimes
Augustana College

We extend James McKays 1959 proof to give a formula for the possible number of elements of order p where p is a prime dividing the order of the group. For example, if p is 5, there may be 4 or 24 elements of order 5, but not 14. Our proof is elementary in the sense that it doesnt invoke the theory of cosets or quotient groups. It does, however, require orbits, stabilizers, and elementary number theory.

9:10–9:25

An Introduction to Loops and Quasigroups

Ashley Weatherwax
University of Texas at Dallas

Anyone that has taken a course in abstract algebra is probably familiar with the concept of a group. If you can recall, a group's binary operation is required to be associative. But what do you get if the operation is not associative? We call a group without associativity a loop and a loop without an identity a quasigroup. This talk explains the general concept of quasigroups and loops and, more specifically, discusses a few properties of a specific variety of quasigroups called LC-quasigroups.

9:30–9:45

Blowups of Algebraic Varieties

Emma Whitten
University of Notre Dame

Blowups provide a useful way to study singularities in algebraic varieties. For example, "blowing up" at a cusp or self-intersection point will often produce a new curve which no longer has that singularity. In this talk we will define the blowup and through motivating examples discuss some of the major theorems (and conjectures) in this area. No algebraic geometry background will be required.

9:50–10:05

Bridging the Group Definition Gap

Matthew Glenn Dawson
Union University

In the early 1830s, a young French mathematician by the name of Evariste Galois laid the foundations of group theory, even though he never precisely defined groups. Galois studied groups in the context of sets of arrangements, and his ideas were reformulated into a more abstract setting in the twentieth century. This presentation provides precise definitions for constructs closely related to Galois' original notion of group theory and explores important group properties in that context, demonstrating that the modern concepts of group, subgroup, normal subgroup, and solvable group can be expressed in terms of arrangement sets.

10:10–10:25

Geometric Truths

Andrew Johnson
Mount Union College

In grade school scores of teachers convince their students that prior to 1492 many disillusioned individuals believed the earth to be a finite plane. Over five hundred years later there is no deviation from the opinion that the world on which we reside is spherical. Though it is universally accepted that our earth is a sphere the primary geometry studied on its surface is of the Euclidean nature. There are numerous differences between Euclidean and spherical geometry, and under rigorous investigation one can become convinced that Euclidean geometry should be acknowledged as abstract theory and spherical geometry considered paramount.

MAA Session #5

Meeting Room R **8:30A.M. – 10:25A.M.**

8:30–8:45

A Linearly Transformed View of Multidimensional Differentiation

Gabriel Caceres
Augustana College

We will consider multi-variable functions and their corresponding full derivatives. This work will provide a quick formal overview of linear transformations, the definition of derivative for maps from $\mathbb{R}^n$ to $\mathbb{R}^m$, and the Jacobian Matrix. We will discuss what this higher dimensional derivative represents, as well as visualizing its effects. We will give examples using one dimensional functions, followed by examples in higher dimensions. Finally we will state formulas for the general case.

8:50–9:05

A Problem Related to the Sendov Conjecture

Haggai M. Nuchi *
Carleton College

The critical numbers of any polynomial function are implicit functions of the polynomial's zeros; by studying the distribution of zeros, we can say certain things about the distribution of critical numbers. The Sendov Conjecture is a statement about the distance from the set of zeros to the set of critical numbers for polynomial functions with zeros in the complex unit disk. We will discuss at least one problem related to this conjecture and share the results of our recent investigations.

*Joint work with: Aaron Shatzer, *Luther College*

9:10–9:25

Confluent Hypergeometric Bernoulli Polynomials

Robert James Booth
Rowan University

It is well known that classical Bernoulli polynomials are a function of one variable, x, and can be used to find sums of arbitrary powers. In 1977, Howard considered a natural generalization of classical Bernoulli polynomials, making them functions of two parameters (N,x), where N is a positive integer. These generalized polynomials are known as hypergeometric Bernoulli polynomials. We have further generalized these polynomials, to allow N to be any real number, utilizing the confluent hypergeometric function. Our new results, appropriate previous results, and some interesting properties of confluent hypergeometric polynomials will be presented.

9:30–9:45

Finite Versions of Rogers-Ramanujan-Slater Type Identities

Eric Werley
West Chester University of Pennsylvania

A "Rogers-Ramanujan-Slater" type identity is an identity containing a variable q which equates an infinite product with an infinite series. A finite generalization of such an identity consists of two sequences of polynomials, such that corresponding terms in each sequence are equal and one sequence tends to the infinite sum and the other sequence tends to the infinite product. Some mathematicians such as Andrew Sills have found finite generalizations of the 130 identities in two papers by Lucy Slater. We will be discussing finding finite generalizations different from those of Sills. We will also show how to recover the infinite versions from these finite generalizations.

9:50–10:05

On measure-preserving transformations over non-archimedean fields and profinite groups

Hansheng Diao
Massachusetts Institute of Technology

We study the measurable dynamics of various transformations on non-archimedean fields, especially p-adic fields and function fields. In the dynamics of certain algebraically defined maps, we see that there is a strong connection between the topological property of minimality and the measure-theoretic property of ergodicity. We also study transformations of other kinds, including translation, multiplication and monomial mappings. This talk is based on the research in 2008 SMALL REU program at Williams College.

10:10–10:25

On the Riemann Sphere in Complex Analysis

Brooks Smith
University of Notre Dame

In the field of complex analysis, the study of the Riemann sphere is of immense importance. Many theorems on complex-differentiable mappings can be more easily stated or proven with the use of this mathematical concept. Meromorphic rational functions over the Riemann sphere are of special interest because of their simplicity. In this talk, we will discuss some of the key results and conjectures in this area and examine how the Riemann sphere is used to prove or study them. No background in complex analysis will be required.

Invited Paper Session

Hall Ideas H **2:00P.M. – 4:00P.M.**

Members and alums of the Williams College NSF SMALL Undergraduate Research Geometry Group and perhaps others will report on work on isoperimetric problems and open questions in various settings, including Riemannian manifolds and manifolds with density (which appeared in Perelman's papers on the Poincaré Conjecture).

MAA student speakers are indicated with an asterisk.

2:00–2:15

Isoperimetric problems, manifolds with density, and the SMALL undergraduate research project

Frank Morgan

Williams College

Giving a manifold a density as in freshman physics, as occurs naturally throughout mathematics and applications, opens up new fundamental questions in geometry. The classical isoperimetric problem seeks the least-perimeter way to enclose a given amount of volume; in Euclidean space, the solution is a round ball. In a manifold with density, the isoperimetric problem seeks the least-weighted-perimeter way to enclose a given amount of weighted volume; the solutions are often surprising. The Williams College NSF SMALL undergraduate research project is now celebrating its 20th anniversary.

2:20–2:35

The Isoperimetric Problem on Surfaces with Density

Alex Dubbs *

Harvard University

The isoperimetric problem on a surface seeks the least-perimeter way to enclose a given amount of area. What if you give the surface a density weighting both area and perimeter? Work of the 2008 NSF SMALL undergraduate research Geometry Group.

2:40–2:55

The Isoperimetric Problem in the Plane with Density r^p

Hung Tran *

Berea College

The least-perimeter way to enclose a given amount of area in the plane with density r^p is not a circle about the origin as you might expect. We report on our efforts to find the answer. Work of the 2008 NSF SMALL undergraduate research Geometry Group.

3:00–3:15

The Geometry of Surfaces with Density

Jon Dahlberg *

Williams College

Providing a surface with a density function leads to new concepts of geometry and curvature. (Such densities appear in Perelman's original paper on the Poincaré Conjecture.)

3:20–3:35

Optimal Partitions of the Sphere

Edward Newkirk *

Williams College

What is the least-perimeter way to partition the sphere into a small number n of equal areas? For $n = 2$, the answer is an equator. The solution is also known for $n = 3$ and $n = 12$. We discuss progress on the case $n = 4$. Work of Conor Quinn and the NSF SMALL undergraduate research Geometry Group.

3:40–3:55

Hypertext Platforms

Joseph Corneli

PlanetMath.org

We will describe a new tool for building hackable multi-user interactive semantic hypertext platforms.

PME Session #1

Meeting Room L **2:00P.M. – 3:55P.M.**

2:00–2:15

How We Roll: The Theory and Construction of the Square Wheel Bicycle

Alicia Brinkman

Saint Norbert College, Wisconsin Delta

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

2:20–2:35

A Somewhat Linear Fixed Point Problem: Introduction and Theory

Ashley Burt

Pepperdine University, California Xi

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

2:40–2:55

A somewhat linear fixed point problem: some results and numerical issues

William B. Cousins

Pepperdine University, California Xi

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

3:00–3:15

A somewhat linear fixed point problem: further results and numerical issues

Brent Hancock

Pepperdine University, California Xi

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

3:20–3:35

Modeling Dynamics of a Volleyball Serve: Choosing the Optimal Trajectory

Daniel Lithio
Hope College, Michigan Delta

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

3:40–3:55

An Introduction to the Hodgkin-Huxley Model

Tyler Drombosky
Youngstown State University, Ohio Xi

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

PME Session #2

Meeting Room M **2:00P.M. – 3:55P.M.**

2:00–2:15

RNA Secondary Structure–A Statistical Analysis

Heather Akerson
College of Saint Benedict, Minnesota Delta

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

2:20–2:35

Genetic Modeling of the White Buffalo

Kathleen Miller
Saint Norbert College, Wisconsin Delta

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

2:40–2:55

Mathematical Model and Experimental Results of Biofilm Growth

David Nassar
The University of Akron, Ohio Nu

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

3:00–3:15

A Dynamical Systems Approach to Stability Tracking of Treadmill Running

Diana Saly
University of New Hampshire, New Hampshire Alpha

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

3:20–3:35

Modeling Diatom Growth in Trout Lake

Corey Vorland

Saint Norbert College, Wisconsin Delta

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

3:40–3:55

Plant-Pathogen Dynamics

Vincent Martinez

The College of New Jersey, New Jersey Theta

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

MAA Session #6

Meeting Room N **2:00P.M. – 3:55P.M.**

2:00–2:15

Erdös-Ko-Rado Madness: Generalizing the Theorem

Greg Brockman
Harvard University

Let F be the set of all k-element subsets of $\{1, 2, \ldots, n\}$, and let $F' \subset F$ be intersecting (that is, every pair of elements of F' has a nonempty intersection). The Erdös-Ko-Rado Theorem states that the maximum size of F' is given by $\binom{n-1}{k-1}$, and this maximum can be constructed in a trivial manner. Now allow F' to be r-intersecting, that is, it can be partitioned into r disjoint subsets such that each subset is intersecting. We'll extend the results of other researchers and very possibly come up with something intriguingly new.

2:20–2:35

Near Universal Cycles Exist for Subsets

Taylor Hines
Arizona State University

Let S be a cyclic n-ary sequence. We say that S is a *universal cycle* ((n,k)-*Ucycle*) for k-subsets of $[n]$ if every such subset appears exactly once contiguously in S, and is a *Ucycle packing* if every such subset appears at most once. Few examples of Ucycles are known to exist, so the relaxation to packings is merits investigation. A family $\{S_n\}$ of (n,k)-Ucycle packings for fixed k is a *near-Ucycle* if the length of S_n is $(1-o(1))\binom{n}{k}$. In this paper we prove for all k that near-(n,k)-Ucycles exist when $n \gg k^2$.

2:40–2:55

Drop Sequences: Generalizing Descents and Inversions

Albert Bush
Southern Polytechnic State University

Permutations statistics such as the number of inversions and descents have been used frequently in combinatorics as well as in other areas. These can be generalized by the concept of a drop. Descents are drops where we check to see if each element is greater than its immediate neighbor. Inversions are drops in which we check to see how many right-hand neighbors are less than each element. Thus, we can form sequences that denote how far down each element will check for an element less than it. Descents would correspond to $(1, 1, \ldots, 1)$, and inversions would correspond to $(n-1, n-2, \ldots, 1)$.

3:00–3:15

Permutation Tableaux and Combinatorial Sequences

Katie Evans

St. Olaf College

In this paper we explore properties of Corteel's bijection between permutations and a new class of objects called permutation tableaux. Corteel defines a special class of permutation tableaux as unrestricted. The main results include a characterization of 231-avoiding permutations as unrestricted tableaux. We also give a bijection between all unrestricted tableaux and set partitions which are counted by the Bell numbers. We conclude with a series of open questions related to permutation tableaux and Corteel's bijection.

3:20–3:35

Some Remarks on Fibonacci-type Polynomials

Tom McCollum

Michigan State University

It is well known that the coefficients of the polynomial $f(x) = (x+1)^n$ form Pascal's triangle. We explore the possibility of forming Pascal-like triangles for other polynomial sequences. In particular, we will give closed form expressions using combinatorial terms for the coefficients of a Fibonacci-type polynomial sequence given by $F_0 = 1$, $F_1 = x+1$, and $F_n = xF_n - 1 + F_n - 2$, for $n = 2, 3, 4 \ldots$. We will also present more general results that correspond to the initial conditions $F_0 = c, F_1 = bx + c$ for any integers b and c.

MAA Session #7

Meeting Room Q **2:00P.M. – 3:55P.M.**

2:00–2:15

A Visual Approach to the Circle-Squaring Problem

Jeffery Willert
The College of Wooster

Inspired by Tarski's Circle-Squaring problem, we seek a method for visualizing the decomposition of a circle which will, after some rearranging, yield a square. We begin by approximating the circle with a 2n-gon, and we illustrate a method for slicing the 2n-gon into pieces which can then be translated to form the final square. As we go through the process, several interesting questions arise. For example: How many pieces will be involved in the cutting of the 2n-gon? Where exactly must we partition the 2n-gon to get the necessary pieces? What happens to the boundaries of the pieces? These and other questions will be explored in this talk.

2:20–2:35

Area Ratios in a Triangle Using Complex Numbers

Elena Georgiana Simion
South Dakota State University

Two points are chosen on each side of a random triangle such that the two segments created on each side by the points chosen and the closest vertex of the triangle are equal and each one of these segments is proportional to the original triangle side with a constant ratio. Lines are drawn through each of these points and the opposite vertex of the triangle; hexagons are formed. We observe that the ratio of the area of the hexagon to the area of the original triangle is constant, depending only on the proportion chosen initially for the two points on each of the triangle's sides. The observation above will be proven using the geometric properties of complex numbers.

2:40–2:55

Clique Replacements for d-Dimensional Polytopes with $d + 4$ Facets

Daniel DiPasquale
Fordham University

A polytope is defined to be the convex hull of a finite set of points. A method called "clique replacements describes the mechanics to go from one combinatorial class of polytopes to another. For the case of d-dimensional polytopes with $d + 4$ facets, we will share our progress in creating criteria for when such replacements yield another polytope and when they do not, as well as related properties.

3:00–3:15

Network Analysis of the Clique Replacement Graph

Amy Wesolowski
College of the Atlantic

A polytope is defined to be a convex hull of a finite set of points. Clique replacement is a technique to produce a new polytope from an existing one. We can create a graph whose vertices are polytopes and whose edges are clique replacements. This talk describes the application of the mathematical tools of emerging complex networks to the clique replacement graph. Statistical methods for quantifying relationships and clusters between elements of the clique replacement graph are used.

3:20–3:35

On the Strong Symmetric Genus of (not too large) Finite Groups

Tova Lindberg
Bethany Lutheran College

We can study Riemann surfaces – a simple example of which would be a sphere – and their automorphism groups through the use of group theory and computational methods. The *strong symmetric genus* of a finite group G is defined as the smallest genus of a compact Riemann surface on which G acts as a group of automorphisms. We extend known classifications of groups with given (small) strong symmetric genus and of the strong symmetric genus of given (small) groups. In this talk, we present some of these classifications.

3:40–3:55

Paths of Least Distance for Polytopes of Higher Dimensions

Peter Craig Thayer
University of Louisiana at Lafayette

We live in a world of three standard spatial dimensions, but we can use math to understand and describe higher dimensions. Polytopes are a generalization of polygons, polyhedra, and the higher-dimensional analogues to figures of any number of dimensions. This presentation will cover how to find the minimal distances along the boundaries of a hypercube and an orthoplex from one vertex to its opposite.

MAA Session #8

Meeting Room R **2:00P.M. – 3:55P.M.**

2:00–2:15

Chutes and Ladders for those with a Short Attention Span

Leslie Cheteyan
Montclair State University

I will review the rules and game board for Chutes and Ladders, define a Markov chain to model the game with any spinner size, and describe how properties of Markov chains are used to determine that the optimal spinner size of 15 minimizes the expected number of turns for a player to complete the game. Because the Markov chain consists of 101 states, we demonstrate the analysis with a 10-state variation with a single chute and a single ladder. The resulting 10 x 10 transition matrix is easier to display and the manipulations are comparable.

2:20–2:35

Did A-Rod Deserve the 2007 AL MVP?

Laura Kazanjian
Emmanuel College

Every year the members of the Baseball Writers of America vote for the player that was the most valuable to their team. A players value is determined by how their contributions to the team helped improve the teams chances of winning. Inspired by an article by Jay Bennett, we looked at how each of the top ten vote getters for the 2007 American League MVP changed their teams probability of winning a game with each at-bat they took. The probability that a team wins a game is based on the situation of the game and each at-bat creates a new game situation. We then compared the probabilities for every player to determine which player really was the most valuable to his team.

2:40–2:55

On the Two-Sided Power Distribution

Amol Kapila
Brown University

We investigate properties of the Two-Sided Power distribution, introduced by van Dorp and Kotz in 2002, eg., hypothesis testing, estimation of parameters, confidence intervals, et al. In addition, the possibility of connections to other distributions, in particular the Laplace distribution, is explored. Finally, we consider the suitability of this distribution as a prior distribution in Bayesian analysis.

3:00–3:15

The Impact of Student Eating Habits on Weight

Ashley Ciesla
Montclair State University

In this study, we examine the effects of commuter eating habits on student weight under the hypothesis that class and work schedules along with limited access to healthy food can lead to infrequent and large meals. Studies have shown that infrequent heavy meals can lower basal metabolic rate tipping the energy-balance equation. In addition, we simulate a mathematical model to predict the five year effect of a lower basal metabolic rate on weight gain.

3:20–3:35

A Model Estimating the Probability of Developing Multiple Sclerosis

Xuyang Tang
College of St. Benedict

Multiple Sclerosis (MS) is a currently incurable autoimmune disease in which the immune system of the patient attacks components of his/her central nervous system. The cause of this disease is still unknown. However, various studies have linked both genetic and environmental factors to the susceptibility and development of MS. I develop a model that estimates the probability of developing MS based on the risk factors associated with MS. It is hoped that this model will help future researchers and physicians better predict and prevent the onset of MS. I will discuss my model, which uses multiple logistic regression analysis, to estimate the probability of a patient developing MS based on a variety of known and suspected genetic and environmental factors.

PME Session #3

Meeting Room L **4:20P.M. – 6:15P.M.**

4:20–4:35

Regression Statistics with Data Subjected to Type II Censoring

Erica Cross
Youngstown State University, Ohio Xi

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

4:40–4:55

Pascal's Triangle in Secondary Education

Jennifer Crounse
Fitchburg State College, Massachusetts Eta

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

5:00–5:15

Fibonacci and Base-2 Psuedoprimes: Can Two Wrongs Make a Right?

Daniel Monfre
Carthage College, Wisconsin Epsilon

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

5:20–5:35

Ordering and Factorization of Sparse Matrices of GF(2)

Seena Vali
Fordham University, New York Alpha Nu

A sparse matrix is made up of mostly zero-entries. They can be inverted or factored into the LUP factorization in the same way as a normal matrix, but there are also special factorization methods which are much faster and more efficient. For example, normally a matrix would be LUP-factored using Gaussian Elimination, but a sparse matrix would quickly become non-sparse with this method. However, a relatively simple reordering of columns and rows of the matrix can postpone this phenomenon and provide a substantial increase in the speed of factorization.

In 1972, D.J. Rose published the MinDegree algorithm, enhanced by many later authors, and described by T. Davis in his book Direct Methods for Sparse Linear Systems, who also implemented the algorithm for MatLab. The MinDegree algorithm operates by manipulating the graph whose adjacency matrix is the matrix being Cholesky factored. However, the algorithm works over the real numbers, and problems arise in cryptography and other fields that work over GF(2). We found that by making a few slight, but crucial changes in the process of degree ordering the matrix, we can arrange the matrix such that the factorization is more efficient and quicker. Using the property that if r and s are nonzero in GF(2), then r + s is zero, we adjust the ordering algorithm which greatly increases the speed of factorization of the sparse matrix. As it turns out, this translates to changing a "logical OR" in deciding which edges to create/destroy in the MinDegree graph to an "exclusive OR."

5:40–5:55

Rolling Smoothly on a Saw-Tooth Road: The Theory for a Wheel

Stephanie Schauer
Saint Norbert College, Wisconsin Delta

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

PME Session #4

Meeting Room M **4:20P.M. – 6:15P.M.**

4:20–4:35

The probability of Relatively Prime Polynomials with Coefficients from Finite Fields

Meghann Barger

Western Oregon University, Oregon Delta

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

4:40–4:55

Towards Proving the Erdos-Faber-Lovasz Conjecture

Abdulmajed Dakkak

University of Toledo, Ohio Gamma

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

5:00–5:15

Thermal Nondestructive Evaluation in Composite Materials with Porosity

Krista Foster

Youngstown State University, Ohio Xi

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

5:20–5:35

Tilings of a Finite Rectangular Region with Rectangular Tiles

Jim Manning

The University of South Carolina, South Carolina Alpha

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

5:40–5:55

Poisson's PDE with Nonhomogeneous BC's

Shira Stav

University of North Carolina at Charlotte, North Carolina Theta

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

6:00–6:15

Dynamical Systems: Sink or Source!

Shawn Case

Fitchburg State College, Massachusetts Eta

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

MAA Session #9

Meeting Room N **4:20P.M. – 6:15P.M.**

4:20–4:35

The Many Tilings of a $2 \times n$ board

Matthew Holland Katz
Juniata College

Tilings are a fun visual way to view certain combinatorial problems. For example, the Fibonacci numbers can be represented as the number of tilings of $1 \times n$ boards using dominos and squares or as the number of tilings of a $2 \times n$ board using only dominos. Stemming from this, a question arises: do any patterns occur if we try to tile the $2 \times n$ board using dominos and squares? Along with answering this question, we can look at combinatorial identities and characteristics of the sequences we find.

4:40–4:55

Your Paths are Determined: Hankel Determinants and Motzkin Numbers

Andrew Yip
Lewis and Clark College

We consider the determinant of the matrix $H_n^t = \left(m_{i+j-2}^t + m_{i+j-1}^t\right)_{1 \le i,j \le n}$ where m_k^t is the number of t-Motzkin paths from $(0,0)$ to $(k,0)$ using northeast steps $(1,1)$, east steps $(1,0)$ and southeast steps $(1,-1)$. The paths never go below the x-axis and the east steps have a weight of t. Our major result is that $|H_n^t| = (t+1)\left|H_{n-1}^t\right| - \left|H_{n-2}^t\right|$, with $|H_0^t| = 1$ and $|H_1^t| = t+1$, which we will prove using a method that counts. We will also investigate the interesting sequences that emerge in the case $t = 1$.

5:00–5:15

Universal Cycles on Simple Graphs

Emma Snively *
Rose-Hulman Institute of Technology

A universal cycle of combinatorial objects is the smallest possible cyclic representation of all objects in a class. For example, 0011 is a universal cycle of 2-letter binary words because it contains each of 00, 01, 11, 10 exactly once. We explore the properties of universal cycles of simple graphs on n vertices. This project was undertaken in conjunction with other members of the 2008 ETSU REU.

*Joint work with: Bill Kay, *University of South Carolina*

5:20–5:35

Vector Coloring

Amanda Schaeffer
University of Arizona

In the usual sense, vertex-coloring a graph consists of coloring each vertex so that any two vertices connected by an edge are different colors. G is k-colorable if we can do this using k colors. We define a vector coloring to be a coloring which assigns to each vertex a vector, where two vertices connected by an edge are assigned orthogonal vectors. If this is possible using vectors in $\mathbb{C}^k$, we say G is k-vector colorable. We examine the properties of coloring methods such as vector coloring and how they can be compared with the existing forms of vertex coloring.

5:40–5:55

Graphs, Coverings, and Characteristic Polynomials

Gabrielle Paoletti *
Canisius College

By the spectrum of a directed graph we mean the eigenvalues of its adjacency matrix, determined by its characteristic polynomial. When a large graph is a covering of a small graph, the second characteristic polynomial is a factor of the first. There are many interesting examples. (*) This talk will present results from this summer's investigations at the Canisius College REU, Geometry and Physics on Graphs.

*Joint work with: Rachel Hunter, *Cornell University*

6:00–6:15

Crystals and quasicrystals

Emily Bargar *
University of Chicago

We study crystal and quasicrystal infinite graphs via two general tools. One tool is the notion of groupoid, including toplogical structure. The other tool is the spectra of families of finite graphs formed by truncating or wrapping the infinite graph. (*) This talk will present results from this summer's investigations at the Canisius College REU, Geometry and Physics on Graphs.

*Joint work with: Vivian Healey, *University of Notre Dame*

MAA Session #10

Meeting Room Q **4:20P.M. – 6:15P.M.**

4:20–4:35

Automated Intelligent Play of Coalition Games

Jason Yoder
Goshen College

A three-player coalition game involves an amount of money $w(ABC)$ that can be shared among three players if each agrees to an allocation. If all three players are unable to agree upon an allocation, a smaller amount $w(AB)$, $w(AC)$, or $w(BC)$ can be shared by the corresponding two players. Players who do not enter into an agreement within a specified time limit receive zero. The Shapley value and nucleolus are two methods for selecting a fair allocation, which may or may not correspond to a negotiated agreement. We report on computer simulated tournaments using a variety of negotiating strategies.

4:40–4:55

Mathematics Maximizes RPG Video Game Development Efficiency

Charles Tannouri
Johns Hopkins University/Towson University

In modern video gaming, the genre of Role Playing Games has grown to be wildly popular. It can be demonstrated that these games follow the basic predicted structures of Game Theory. However, the question arises how to manipulate these structures to aid in optimizing the development and testing process of these games. A generic model of a Role Playing Game will be analyzed per the principles of Game Theory and exemplified to demonstrate methods for determining these optimization strategies.

5:00–5:15

Going Once, Going Twice, Sold; Modeling Different Auction Types

Katrina Housholder *
Simpson College

Auction theory is a branch of game theory which deals with how people act in auction markets and studies auction design with regards to efficiency, optimal bidding strategies, and revenue comparison. Recently, auction theory has played an important role in the development of new auction systems designed for the privatization of public-sector companies and the sale of licenses for use of the electromagnetic spectrum. This talk will highlight the research we conducted at Simpson College during the summer as we introduced ourselves to this area of study.

*Joint work with: Chad Onstot and Emily Wagoner, *Simpson College*

5:20–5:35

An Application of Auction Theory to the MLB Free Agent Market

Zhishan Guo *
St. John's University

Major League Baseball has a bidding system for free agency players that goes back more than ten years. By compiling past free agent salaries we hope to find trends in the distribution of how they compare to each other over a certain period. There exist many examples of teams overpaying for some of their free agents and this is known as “the winners curse in auction theory. There are many methods in auction theory for resolving “the winners curse, including two stage sealed bid auctions based upon the work of Brams and Taylor. We will apply such ideas in the hope of finding an alternative system for bidding for free agents in major league baseball.

*Joint work with: Carson Paul Sievert, *St. John's University*

5:40–5:55

Monotonic Power Indices

Gina Marie Richard
Goshen College

United States legislation requires approval by the President and simple majorities of the Representatives and of the Senators, or approval by two-thirds majorities of the Representatives and of the Senators. Four well-known power indices assign the President between 4% and 77% of the a priori voting power in this simple game. Given this wide range of answers and a variety of power index paradoxes cited in the literature, it is important to clearly define what properties a power index should satisfy. The goal of this work is to characterize all power indices satisfying the symmetric, dummy independence, and monotonicity properties.

6:00–6:15

Who's on my Team?

Kristin Bertram
Winona State University

You are enjoying a beautiful sunny day with your friends at the beach when someone says, "Let's play volleyball!" Nominated as a captain, you wonder, "What strategy for picking teammates will guarantee my team will win?" A game of volleyball can be modeled with Markov Chains and transition matrices whose components depend upon the ability of the teams' players. We use Markov chains to "play" games of volleyball with two teams whose players where chosen via a number of different drafting strategies. In this talk, we will discuss constructing our model for volleyball as well as our findings of the best drafting strategy.

MAA Session #11

Meeting Room R **4:20P.M. – 6:15P.M.**

4:20–4:35

Common Modulus Attacks on RSA and How RSA Security Works

Nicole Riveness
Winona State University

RSA is a cryptosystem, or system for encoding and decoding secret messages, invented in the 1970s by Rivest, Shamir, and Adleman. It is pivotal for innocent people to become familiar with the steps that hackers take in attempting to steal personal information even from a secure system like RSA. In this talk, you will gain a grasp on how RSA works and what you can look for to avoid getting your identity stolen. Some calculations of the RSA cryptosystem and an example of a common modulus attack will be presented in this talk.

4:40–4:55

Finding Sequences of Primes

Elijah Allen
Armstrong Atlantic State University

Determining if a sequence of numbers are all prime can be a long process. In this talk we will discuss a new algorithm that finds sequences of primes by finding numbers that mean a set of conditions and using such numbers to generate the desired sequence of prime numbers. That is, this algorithm finds one number that makes all of the others prime instead of trying to find multiple primes at the same time.

5:00–5:15

Perfect Numbers and Mersenne Primes

Megan Placko
Winona State University

Even perfect numbers and Mersenne primes are used together in one of the oldest unsolved problems: how many Mersenne Primes are there? What is the largest Mersenne Prime? It was just in 2006 when the 44th Mersenne Prime number was found using the Lucas-Lehmer Test. Do odd perfect numbers exist? Much of the research that is being done in the field of Cryptography is based around these types of numbers. Mersenne Primes, Even Perfect Numbers, and Odd Perfect Numbers will be discussed in this presentation.

5:20–5:35

Riemann Zeta Function and the prime numbers

Anthony David Varey
Winona State University

The Riemann Hypothesis is regarded as one of the most important open questions in mathematics today. The problem began with the simplified version of the Zeta function dealing real valued exponents, and was extended by Bernhard Riemann to include complex exponents. There is a connection between the Zeta Function and the distribution of the prime numbers, as discovered by Leonhard Euler who also proved the identity. When this hypothesis is proven true, our security systems in place today would be vulnerable to attack, but it will give us a very useful tool in number theory.

5:40–5:55

The Behavior of DS-Divisors of Positive Integers

Elizabeth Arango
Montclair State University

We study behavior of DS-divisors of positive integers. Here, "DS" stands for "divisor-squared" and for an integer c , a positive integer q is called a DS-divisor of c if $q^2 \mid c - q.$ Such a pair $(c, q),$ is called a DS-pair. From a table generated for DS-pairs, we examine the existence and the numbers of positive DS-divisors of prime powers, product of two primes, and other cases. We also investigate patterns and structures of DS-divisors based on our observations of the table. In addition, we investigate the relationship between DS-divisors and Euler Numbers.

MAA Session #12

Meeting Room L **8:30A.M. – 10:25A.M.**

8:30–8:45

A Modeling Perspective of Subprime Mortgage Lending

Richelle Reed
Manchester College

The subprime mortgage crisis is an economic problem that could send the American economy into recession. The crisis has led to an overwhelming number of foreclosures for U.S. homeowners. We construct an epidemiological model with nonlinear ordinary differential equations. The model seeks to examine the dynamics of the housing situation through stability analysis of our system of ODEs in order to identify the impact of intervention on the renters-owners system.

8:50–9:05

Optimization as a Competitive Weapon: Mathematical Techniques that Slash Costs

Nicole Beauchamp
Eastern Connecticut State University

Optimization encompasses a logical, systematic approach to real world problem solving, which closely parallels the scientific method. Utilizing established mathematical principles, large amounts of information is translated into an objective function and constraints (if applicable). Once the objective function and constraints have been defined, a wide array of methods can be used to solve the problem. Three of these methods will be considered: Calculus, the Simplex Method and graphical solutions. Finally real world case studies will be examined to see how mathematicians have used optimization to save companies millions of dollars.

9:10–9:25

Q-Value Method for A Publishing Company to Allocate ISBN

Yisha Peng
Zhejiang University

How to allocate the limited amount of ISBN is vital for a publishing company. The categories of books having stronger competitive power in the market should be assigned larger amount of ISBN, to maximize profit. In this talk, we use the multilevel dynamic fuzzy method to quantify the competitive power, taking both market share and the degree of satisfaction into consideration. More interestingly, we absorb the principal of economics to redefine the terminology in our model, such as taking ISBN as investment element and embed it into the D'Hondt Q-Value Equation. Finally we interpret our model from economics perspective vividly.

9:30–9:45

On Dependent Binomial Processes

Stephanie Sapp
Johns Hopkins University

We explore binomial processes in which the conditional probability of a success in each trial is dependent upon the rate of success in previous trials. The possibility of generalizations to processes in which the success rate varies from trial to trial and generalizations to other probability distributions will be investigated. Futhermore, we consider the possibility of Central Limit Theorems in this area.

9:50–10:05

Revised Win Probabilities in California Football

Rory Martin Tiedemann
Mount Union College

We determine the probability of University of California winning a football game based on the situation (time remaining, point differential, field position, and possession). Other variables, such as timeouts remaining, location of game, strength of opponent, and playing surface, as well as normality of data will also be explored. An aim of the experiment is to use the final results as a tool to evaluate the offensive, defensive, and special team units' performance.

10:10–10:25

Using Recursion to Solve the Pill Problem

Kaleb Waite
Rockhurst University

Lets say you have a bottle of 500mg tablets, but you only need to take a 250mg dose each day. To solve this dilemma, each day you open the bottle to take a tablet– if you grab a 500mg tablet you break it in half and put the other 250mg tablet back in the bottle. This process is then repeated each day. This raises the question: What is the probability on the nth day that the tablet you grab will be a whole tablet? We use recursion to investigate this question and implement a Java program to perform the calculations.

MAA Session #13

Meeting Room M **8:30A.M. – 10:25A.M.**

8:30–8:45

Equal Circle Packing

Sandi Xhumari
Grand Valley State University

What are optimal packings of equal circles on a torus? In this presentation, we will show you all optimal packings of 6 equal circles on a flat torus, how we went about finding them and how we proved them to be optimal. The proof uses tools from several different mathematical areas including graph theory. Using numerous pictures we will introduce you to all the basic concepts (including the notion of a flat torus, an optimal packing and the graph of a packing) and guide you through our proof.

8:50–9:05

Happiness in Random Matchmaking

James Brantner
Erskine College

This presentation will explore properties of Latin Squares and their relationship to the happiness of randomly matched couples. Specifically, we consider n men and n women with preference matrices described by Latin Squares. We are interested in the aggregate happiness of the group when couples are randomly matched. This project was undertaken in conjunction with other members of the 2008 ETSU REU.

9:10–9:25

L(3,2,1) Graph Labeling

Jeremy Ward *
Simpson College

The L(3,2,1)-labeling of a graph is a simplified version of the channel assignment problem, in which a positive integer label is assigned to each vertex of a graph by considering the distance between vertices. This talk will introduce L(3,2,1)-labeling and highlight some research results from the Simpson College summer research program.

*Joint work with: Michelle Lingscheit and Kiersten Ruff, *Simpson College*

9:30–9:45

Length-minimization problems on non-planar surfaces

Jodi Haponski
Clarion University of Pennsylvania

Steiner problem for n fixed points on a surface is to find the least length path network connecting the given n fixed points. This problem has been studied extensively in the plane and algorithms for constructing solutions are well known in this setting. However, until recently very little had been done in terms of solving Steiner problems on other surfaces. We will present the latest developments in solving Steiner problems on more general piecewise smooth surfaces.

9:50–10:05

On the Construction of Knights' Tours

Evan Cobb *
Saint Louis University

The problem of the knight's tour has been considered by many mathematicians, including Euler, for centuries. The question is this: for what $m \times n$ chessboards is it possible for a knight, using legal moves only, to touch every space on the board exactly once and then return to his original position? Using a graph theory approach developed by Schwenk, we demonstrate how to inductively construct a knight's tour on any chessboard for which a tour is possible.

*Joint work with: Richard Andrew Fields, *Saint Louis University*

10:10–10:25

Social Networks and their Natural Behavior

Chanda-Louise Oton
CUNY Hunter College

Our point of interest was to understand how existing social networks behave. We researched various scientific papers to determine the structural make up of various types of social networks. The objective was to compare and contrast the structure of various social networks, and determine the characteristics which were consistent in the majority of social networks studied.

MAA Session #14

Meeting Room N **8:30A.M. – 10:25A.M.**

8:30–8:45

How many minimal lattice knots are there?

James Andrew Costa
UC Berkeley

Our research group is interested in accurately modeling type II topoisomerase action. In order to do this we model knotted DNA using self-avoiding polygons (SAPs) in the simple cubic lattice. We use a Monte-Carlo based algorithm called BFACF to generate the polygons and explore all possible configurations of a specific knot type for a desired range of lengths. I will here discuss the theoretical ramifications of this project.

8:50–9:05

Knots and Differential Equations

Rachel Hudson
Williams College

In 1995, Robert Ghrist showed that there was a single system of ordinary differential equations on 3-space such that every knot appeared as a periodic orbit in the system. Here we consider two distinct vector fields, but with only linear flow lines, and we allow switching between them. We then consider what knots can occur.

9:10–9:25

Projective Knot Invariants

Olga Turanova
Barnard College

A knot, which is a closed curve living in 3-space, may always be projected onto a plane. The result, a curve in 2-space, is at times easier to study than the knot itself. Such an approach allows for the definition of several fruitful invariants, ones based on projections of a knot. We will introduce several such invariants and provide examples of their applications to computing standard knot invariants.

9:30–9:45

Regular Conformations of $(2n, 2)$-Torus Links

Hunan Chaudhry
Benedictine University

An α-regular conformation of a knot (or link) K is a polygonal embedding of K in space such that all edges have the same length and all angles between adjacent edges are equal to α. The α-regular stick number of K is the minimum number of sticks required to construct an α-regular conformation of K. We construct α-regular conformations of $(2n, 2)$-torus links, where $\alpha = \cos^{-1}(-1/3)$. These conformations provide good upper bounds for α-regular stick numbers and, in some cases, realize α-regular stick numbers.

9:50–10:05

Stick Knots

Ralph Morrison
Williams College

How many sticks glued end-to-end does it take to construct a given knot? This is one of the fundamental questions in knot theory, and is particularly relevant for chemists, who would like to synthesize knotted molecules. To obtain the stick number of a knot, you must show that it can be constructed with that number of sticks and demonstrate that no fewer number of sticks will suffice. We will discuss the results we obtained this summer on this interesting invariant.

10:10–10:25

Superinvariants for Knots

Laura Starkson
Harvard University

In 1954, Horst Schubert defined the bridge number of a knot. It has become one of the most important invariants associated to knots. In 1985, Nicolaas Kuiper defined superbridge number. More recently, the idea of turning other traditional knot invariants into superinvariants has proved fruitful. We will discuss the original knot invariants and their "super" cousins, and what we know about them so far.

MAA Session #15

Meeting Room Q **8:30A.M. – 10:25A.M.**

8:30–8:45

Gerrymandering, Convexity, and Shape Compactness

Emily Marshall *
Dartmouth College

The American Heritage Dictionary defines gerrymandering as the act of “dividing a geographic area into voting districts so as to give unfair advantage to one party. The problem of gerrymandering has led to the development of several mathematical measures of shape compactness, some of which have been used in court cases to argue for or against the legality of congressional redistricting plans. In this talk, we will show how the notion of convexity can be used to detect irregularly shaped districts. We will explore both theoretical and empirical aspects of this convexity-based measure of shape compactness.

*Joint work with: Geoff Patterson, *Grand Valley State University*

8:50–9:05

The Geometry of Compact Sets

David Montague *
University of Michigan

The Hausdorff metric provides a measure of distance between compact sets in any complete metric space. The metric is important for its applications in fractal geometry, image matching, visual recognition by robots, and computer-aided surgery. In this presentation, we will focus on the geometry this metric imposes on the space of compact subsets of n-dimensional real space, with a special emphasis on fascinating and unexpected properties of segments in this space.

*Joint work with: Molly J. Visscher, *Earlham College*

9:10–9:25

Soliton solutions to the modified Korteweg-de Vries equation

Antonio Lopez
University of Texas at Arlington

The modified Korteweg-de Vries equation $u_t - 6u^2u_x + u_{xxx} = 0$ is considered and its soliton solutions are derived in a systematic way. A Mathematica program is prepared to produce such solutions and their animations.

9:30–9:45

The Incan Quipu: More than Just a Piece of String

Meridith Thornton
Lipscomb University

This paper explores the Incan culture of South America and their incorporation of the quipu into their civilization. It discusses in depth the placement and colors of the chords, and placement and types of knots in the quipu, especially the use of a decimal system. It also discusses the importance of a quipucamayoc in the Incan society and the history of research done in the field. Finally, it reveals some of the most important discoveries surrounding the quipu and the accomplishments of the Incan civilization.

MAA Session #16

Meeting Room R **8:30A.M. – 10:25A.M.**

8:30–8:45

Parabolas and Their Tangent Lines

Michelle Westrick
Saginaw Valley State University

Let $f(x) = x^2$ when $x \geq 0$ and $-x^2$ when $x < 0$. We construct a chain of tangent lines on the graph of f, starting from an arbitrary point $P(a, a^2)$, $a > 0$ and explore many geometric sequences that emerge from the relationship between the sequence $t_{a,n}$ of tangent lines and the graph of the function $f(x)$. Then we investigate the cases in which x^2 is replaced by certain parabolas of the form $Ax^2 + Bx + C$, where A,B,C are real numbers and $A \neq 0$.

8:50–9:05

Paradoxical Euler or Integration by Differentiation

Andrew Fabian
Rowan University

This presentation will highlight a portion of Euler's paper, E236 Exposition de quelques paradoxes dans le calcul integral (Explanation of certain paradoxes in integral calculus), in which Euler examines some peculiar differential equations that can be solved through the rather paradoxical method of integration by differentiation. He presents four such problems, which we found to all be members of the same family of differential equations, thus this presentation will focus on reworking several of these problems to make use of this generalization.

9:10–9:25

Proving length minimization using metacalibrations

Stephanie Uhl
Brigham Young University

Minimizing perimeter for enclosing area is one of the oldest problems in mathematics. A new method called metacalibrations provides nice proofs for circles and other figures.

9:30–9:45

Relationship of cubic functions and their tangent lines

Kristin Michelle Zaiki
Saginaw Valley State University

A sequence of tangent lines build up carefully from an arbitrary point $P(a, a^3), a > 0$, on the graph of the function $f(x) = x^3$. Previously D. Elbers and T. de Alwis have shown that any two consecutive areas that are squeezed between those tangent lines and the graph of $f(x)$ must have a fixed ratio. We extended their result to explore many other geometric sequences that emerged from the relationship between this sequence of tangent lines and the graph of $f(x)$. We investigate, also, similar situations with the function $f(x) = x^{1/3}$.

9:50–10:05

Trapped bubbles

Jared Drew Johnson
Brigham Young University

A new method called metacalibration provides beautiful proofs for minimization questions involving both fixed boundary and enclosed area or volume. We will discuss some examples.

10:10–10:25

Analysis of Chuck Close Portraits

Sarah Boyenger *
Salem College

Chuck Close is an American painter and photographer who is known for his portraits that are a mosaic of blocks called ”marks”. These portraits have a strange duality – the faces appear three-dimensional and clear from far away, but flat and unfocused at closer distances. We present the results of our mathematical analysis of Close’s portraits, using wavelets and other mathematical tools.

*Joint work with: Clara Ellen Madsen, *College of Idaho*

MAA Undergraduate Student Activities Sessions

WHAT IS THE COLOR OF MY HAT?

Ezra (Bud) Brown
Virginia Tech

Ballroom A

Games involving hats are all the rage these days. In these games, hats of specified colors are placed on players' heads. You can see the colors of some or all of the other players' hats, but not your own. In general, the object is to guess your own hat color. In some games, you may only mention a color. In some games, you may pass. Wrong guesses may or may not be penalized. Sometimes the players are not allowed to communicate with each other during the game. In each case, players meet in advance and plan a strategy that will allow some maximal number of players to correctly guess the colors of their hats. During this session we will describe several Hat Games and the participants will act them out. Hats will be provided!

MATHEMATICS IN FORENSICS

Dan Russell
Oklahoma State Bureau of Investigation

Ballroom B

When people think of forensic science, most people don't immediately think of the ever increasing role that mathematics plays in solving crimes. This presentation will focus on the many ways that mathematics impacts the forensic community and its ability to aid law enforcement in determining the actual events of a suspected criminal act.

PME Session #5

Meeting Room L **2:00P.M. – 4:55P.M.**

2:00–2:15

Order Dimension of Subgroups

Iordan Ganev

Miami University, Ohio Delta

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

2:20–2:35

Finite Hexagonal Arrays Produced by Pascal's Algorithm

Lisa Hickok

University of Illinois at Urbana-Champaign, Illinois Alpha

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

2:40–2:55

An Altermate Proof of the Anti-Pasch Conjecture

Sara Jensen

Carthage College, Wisconsin Epsilon

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

3:00–3:15

On the Seymour Second Neighborhood Conjecture

Bill Kay

University of South Carolina, South Carolina Alpha

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

3:20–3:35

How to Obtain Algebraic Information from Zero-Divisor Graphs

Brendan Kelly

The College of New Jersey, New Jersey Theta

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

3:40–3:55

Can You Spare a Square?

Kevin Kreighbaum
Mount Union College, Ohio Omicron

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

4:00–4:15

Universal cycles of classes of sequences

Arielle Leitner
California State University, Chico, California Omicron

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

4:20–4:35

A Lower Bound on the Barycentric Davenport Constant

Nathan St. John
Miami University, Ohio Delta

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

4:40–4:55

Group Presentations, Cayley Graphs, Markov Processes

Peter Olszewski
Fairfield University, Connecticut Gamma

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

PME Session #6

Meeting Room M **2:00P.M. – 4:55P.M.**

2:00–2:15

On Methods of Calculating Zeros of the Derivatives of the Riemann Zeta Function

Yair Goldberg
The University of North Carolina at Greensboro, North Carolina Epsilon

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

2:20–2:35

An Introduction to Degree Theory in $\mathbb{R}^n$

Damon Haught
Youngstown State University, Ohio Xi

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

2:40–2:55

Symmetries of Polynomials

John Hoffman
Youngstown State University, Ohio Xi

Discuss possibilities of symmetries of polynomials and the possibility of a slant symmetry.

3:00–3:15

An Elementary Classification of Symmetric, Additive 2-cocyles

Adam Hughes
University of Illinois at Urbana-Champaign, Illinois Alpha

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

3:20–3:35

Can 2008 be the first digits of 2^n?

William Ryan Livingston
Youngstown State University, Ohio Xi

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

3:40–3:55

Trigonometric Identities

Jared Ruiz
Youngstown State University, Ohio Xi

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

4:00–4:15

A Method for Determining Rows of Pascal's Triangle Modulo 3

Douglas R. Smith
Miami University, Ohio Delta

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

4:20–4:35

The Cauchy Condensation Test

Moriah Wright
Youngstown State University, Ohio Xi

We will use the Cauchy Condensation Test to explore some interesting properties of convergent and divergent series.

4:40–4:55

Numerical Semigroups and Wilf's Conjecture

Jeremy Thompson
United States Air Force Academy, Colorado Gamma

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

PME Session #7

Meeting Room N **2:00P.M. – 4:55P.M.**

2:00–2:15

Determining Instrinsic Triple Linking in Straight-Edge Embeddings of K_9

Samuel Behrend

Denison University, Ohio Iota

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

2:20–2:35

Dual Dilation Two-Interval Wavelet Sets

Kristin Creech

University of Texas at Arlington, Texas Iota

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

2:40–2:55

Algebraic Properties of h-Vectors Associated to Certain Simple Convex Polytopes

Cheyne Miller

Iona College, New York Psi

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

3:00–3:15

Fibonacci Numbers in Architecture

Allison Wiland

Youngstown State University, Ohio Xi

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

3:20–3:35

Using Tangent and Normal Vectors to Investigate Knots

Samuel Taylor

The College of New Jersey, New Jersey Theta

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

3:40–3:55

What I Did with My Summer

Kristal Temple

Western Oregon University, Oregon Delta

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

4:00–4:15

Partial Differential Equation Model of Traffic Flow

Doug Wajda

Youngstown State University, Ohio Xi

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

4:20–4:35

Introduction to Sudoku for the Algorithmically-Minded

Ryan Pavlik

Saint Norbert College, Wisconsin Delta

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

MAA Session #17

Meeting Room Q **2:00P.M. – 4:55P.M.**

2:00–2:15

Alternative Potential Term in Schrödinger Equation

Bradley Richard Schorer

Linfield College

The simple harmonic oscillator (SHO) model is a useful approach with bounded potentials for a one dimensional hydrogen atom. However, according to empirical evidence, the actual potential is asymmetric and exhibits asymptotic behavior at a certain potential. This creates a problem in the SHO model, as it does not experience such characteristics, and as a result, is only accurate at low energies. We propose a new potential that better resembles empirical data, and compare the energy eigenvalues of the Schrödinger equation to accepted energy values.

2:20–2:35

Bending-Torsion Elastic Instability of Cantilevered Beams

Kristopher Bunker

Michigan Technological University

A parametric technique is used to investigate divergence and flutter failure modes of a slender, cantilevered elastic beam with a mass at the free-end. A familiar example of this would be a stop sign flapping in the wind. The non-coincident mass and shear centers couple torsion and bending in a system of two coupled partial differential equations (PDE). The parametric technique exploits separation of variables, general solutions from ordinary differential equations, and linear algebra to generate solutions to the coupled PDE satisfying appropriate boundary conditions.

2:40–2:55

Masterful Masts: Beam Buckling with Intermediate Follower Loads

Matthew Kassel

Michigan Technological University

Elastic buckling of Euler-Bernoulli beams (built-in at one end and free-free at the other) with intermediate follower loads is investigated. Follower forces always act along the beam like the stays or shrouds which hold the mast on a sailboat up. We investigate the effect on beam failure of follower loads at intermediate points on the beam. Linear algebra, separation of variables, and ordinary differential equation techniques give solutions of the Euler-Bernoulli partial differential equations satisfying appropriate boundary and matching conditions. Non-unique solutions indicate failure of the structure. We investigate divergence and flutter failure modes parametrically.

3:00–3:15

Modeling of Delamination Growth under Big Gas Pressures

Marius Balla

Gainesville State College

Delamination is the separation of the surface layer from the solid body. The problem about the growth of the delamination under gas diffusion into it was considered. The necessary calculations for predicting the growth of a small crack are very complex. The modeling requires the solution of coupled problem of elasticity theory about the crack opening and diffusion problem of gas diffusion into the crack cavity. The analytical solution for the radius of the growing crack driving by gas pressure with time was obtained.

3:20–3:35

Soliton solutions to the nonlinear Schrödinger equation

Crystal Red Eagle *
University of Texas at Arlington

We consider solitary wave (soliton) solutions to the nonlinear Schrödinger equation $iu_t + u_{xx} + 2|u|^2u = 0$. Their physical importance is studied, and a Mathematica program is presented producing such soliton solutions and their animations.

*Joint work with: Samuel Rivera, *University of Texas at Arlington*
3:40–3:55

Solitons and the Korteweg-de Vries equation

Ernesto Garcia *
University of Texas at Arlington

The Korteweg-de Vries equation $u_t - 6uu_x + u_{xxx} = 0$ is used as a model to describe propagation of water waves in long, narrow, shallow canals. We consider solitary wave (soliton) solutions to the Korteweg-de Vries equation, analyze their properties, and animate them using the symbolic software Mathematica.

*Joint work with: Carolina Veronica Liskey, *University of Texas at Arlington*
4:00–4:15

The Fourier Series and the Heat Equation

Daniel Moeller
University of Notre Dame

Harmonic analysis is an extension of Fourier analysis. The Fourier series was originally introduced by Joseph Fourier as the solution to the heat equation. No general solution was known before this time. In this talk we will discuss the Fourier series as a solution to the heat equation and some of its basic properties. No background in Harmonic analysis will be required.
4:20–4:35

The Mathematics of Brass Instruments

Dylan Asmar
United States Air Force Academy

This talk explains the mathematics of brass instruments. Expanding on basic wave functions, it will explain the role that each part of the instruments serves in the production of sound. It will also cover how external factors such as dents and mutes affect the overall mathematics.
4:40–4:55

The Uneven "Dumbelled" Beam

Kristin Kim Schmidtke
Michigan Technological University

We consider the elastic buckling of a thin beam, described by the Euler-Bernoulli partial differential equations, with boundary conditions describing asymmetric end masses and sub tangential loading. A parametric technique (based on separation of variables, general solutions of constant coefficient linear ordinary differential equations, linear algebra, and implicit differentiation) is used to compute divergence and flutter failure modes of this system. The failure loads differ substantially from the previously studied built-in and simply-supported boundary conditions.

MAA Session #18

Meeting Room R **2:00P.M. – 4:55P.M.**

2:00–2:15

Configurations of Extremal Even Unimodular Lattices

Scott Duke Kominers

Harvard University

We introduce the notion of an extremal even unimodular lattice and extend the results of Ozeki on the configurations of extremal even unimodular lattices. In particular, we have the following configuration results: If L is an extremal even unimodular lattice of rank 56, 72, or 96, then L is generated by its minimal-norm vectors and if L is such a lattice of rank $40r$ $(r = 1, 2, 3)$, then L is generated by its vectors of lengths $4r$ and $4r + 2$.

2:20–2:35

Curves

Josh Mollner

University of Notre Dame

The study of curves is a major one in algebraic geometry. Perhaps the simplest two cases are those of conics and cubics. The conic is a classical example of an algebraic curve known to the Greeks and cubic curves (which include Elliptic curves) were recently used in the proof of Fermat's Last Theorem. In this talk we will discuss some important results and conjectures in this area. By looking at both algebraic and geometric properties of the curves we will try to motivate current research and results. No algebraic geometry background will be required.

2:40–2:55

Decompositions of Symmetric Spaces

Karol Koziol

New York University

Cartan demonstrated that it is possible to embed a symmetric space isometrically into a Lie group. Thus, by considering various decompositions of this Lie group, we arrive at corresponding decompositions of the symmetric space itself. We examine this situation for several low dimensional examples, and attempt to generalize to higher dimensional cases.

3:00–3:15

Factoring Binomials

Eric John Robinson

United States Air Force Academy

We will discuss the factorization of binomials based upon the prime factorizations of their variables. We will explore different cases in which the binomial does or does not factor.

3:20–3:35

Finite C-Groups

Candace Andrews

University of Texas at Tyler

Discussion will focus on known results concerning the characterization of Finite C-Groups. Methods for determining C-Groups will be explained and terminology will be introduced.

3:40–3:55

Mappings Between Pieces of a Polynomial Ring

Jeffery Vincent Zylinski
Michigan Technological University

If R is a polynomial ring in r variables and I a module, we say that $A = R/I$ is graded if it can be written as $\bigoplus A_i$ where $A_i \times A_j \to A_{I+j}$. We present a theorem which determines whether or not A must have the property that $L^d : A_i \to A_{i+d}$ has maximal rank $\forall i, j$ (the Strong Lefschetz Property) given the dimensions of the A_i.

4:00–4:15

Order 6 Quandle Decomposition

Joshua Langford
University of Texas at Tyler

A brief overview of the decomposition of quandles, a group-like structure, of order six consisting of a review of the number of quandles of order six followed by a look at how many of those can be decomposed.

4:20–4:35

Symmetry Groups of Near-Cubes

Ed Karasiewicz *
Lafayette College

A d-cube is defined as the set of all points whose coordinates lie between 0 and 1 in all d dimensions. The d-cubes have a high degree of geometric symmetry. The size of the symmetry group of a d-cube is $2^d * d!$. Clique replacements is a method of forming new polytopes from existing polytopes. We will be investigating the size and nature of the symmetry groups of near-cubes, which are the polytopes that are only a few clique replacements away from the d-cube.

*Joint work with: Patrick Kelley, *Lafayette College*

J. Sutherland Frame Lectures

2008	John H. Conway	*The Symmetries of Things*
2007	Donald E. Knuth	*Negafibonacci Numbers and the Hyperbolic Plane*
2006	Donald Saari	*Ellipses and Circles? To Understand Voting Problems??!*
2005	Arthur T. Benjamin	*Proofs that Really Count: The Art of Combinatorial Proof*
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*

Pi Mu Epsilon would like to express its appreciation to the American Mathematical Society and to the Committee for Undergraduate Research, the Society for Industrial and Applied Mathematics, the SIGMAA-Environmental Mathematics and BioSIGMAA for the sponsorship of the Awards for Outstanding Presentations. It would additionally like to thank the National Security Agency for its continued support of the student program by providing subsistent grants to Pi Mu Epsilon speakers.

MAA Lectures for Students

2008	Laura Taalman	*Sudoku: Questions, Variations and Research*
2007	Francis Edward Su	*Splitting the Rent: Fairness Problems, Fixed Points, and Fragmented Polytopes*
2006	Richard Tapia	*Math at Top Speed: Exploring and Breaking Myths in Drag Racing Folklore*
2005	Annalisa Crannell & Marc Frantz	*Lights, Camera, Freeze!*
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*

PI MU EPSILON

President:
David Sutherland
Hendrix College

President Elect:
Eve Torrence
Randolph-Macon College

Past-President:
Joan Weiss
Fairfield University

Secretary-Treasurer:
Leo Schneider
John Carroll University

Councilors:
Paul Fishback
Grand Valley State University

Jacqueline Jensen
Sam Houston State University

Kendra Kilpatrick
Pepperdine University

Angela Spalsbury
Youngstown State University

Editor, PME Journal:
Brigitte Servatius
Worcester Polytechnic Institute

MAA Committee on Undergraduate Activities and Student Chapters

Kay Somers, **Chair**
Moravian College

Linda Braddy
East Central University

Jean Bee Chan
Sonoma State University

John Hamman
Montgomery College

Deanna Haunsperger
Carleton College

Jacqueline A. Jensen
Sam Houston State University

Mario Martelli
Claremont McKenna College

J. Lyn Miller
Slippery Rock University

Michael O'Leary
Towson University

Tatiana Shubin
San Jose State University

Daluss Siewert
Black Hills State University

Diana Thomas
Montclair State University

Gerard Venema
Calvin College

J. Michael Pearson, *ex officio*
Mathematical Association of America

James Tattersall, *ex officio*
Providence College

Robert Vallin, *ex officio*
Mathematical Association of America

Joan Weiss, *ex officio*
Fairfield University