Pi Mu Epsilon

Pi Mu Epsilon is a national mathematics honor society with 338 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 its 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

All events are at the Omni William Penn Hotel

Wednesday, August 4

Time:	**Event:**	**Location:**
2:00 pm - 4:00 pm	CUSAC Meeting	Parkview East
4:30 pm - 5:30 pm	MAA/PME Student Reception	Sky Room
5:30 pm - 6:15 pm	Math Jeopardy	Urban Room

Thursday, August 5

Time:	**Event:**	**Location:**
8:30 am - 11:30 am	PME Council Meeting	Oakmont Room
8:30 am - 10:25 am	MAA Session #1	Conference B
8:30 am - 10:25 am	MAA Session #2	Conference C
8:30 am - 10:25 am	MAA Session #3	Phipps
8:30 am - 10:25 am	MAA Session #4	Oliver
8:30 am - 10:25 am	MAA Session #5	Carnegie III
8:30 am - 10:25 am	MAA Session # 21	Three Rivers Room
9:00 am - 5:00 pm	Student Hospitality Center	Riverboat Room, Lower Level
1:00 pm - 1:50 pm	MAA Lecture for Students	Grand Ballroom, Theater 900
2:00 pm - 3:55 pm	MAA Session #6	Conference B
2:00 pm - 3:55 pm	MAA Session #7	Conference C
2:00 pm - 3:55 pm	MAA Session #8	Carnegie III
2:00 pm - 3:55 pm	PME Session #1	Phipps
2:00 pm - 3:55 pm	PME Session #2	Oliver
4:00 pm - 6:15 pm	MAA Session #9	Conference B
4:00 pm - 6:15 pm	MAA Session #10	Conference C
4:00 pm - 6:15 pm	MAA Session #11	Carnegie III
4:00 pm - 6:15 pm	PME Session #3	Phipps
4:00 pm - 6:15 pm	PME Session #4	Oliver

Friday, August 6

Time:	Event:	Location:
8:30 am - 10:45 am	MAA Session #12	Conference B
8:30 am - 10:25 am	MAA Session #13	Conference C
8:30 am - 10:25 am	MAA Session #14	Carnegie III
8:30 am - 11:55 am	MAA Session # 22	Three Rivers Room
8:30 am - 11:45 am	PME Session #5	Phipps
8:30 am - 11:45 am	PME Session #6	Oliver
9:00 am - 5:00 pm	Student Hospitality Center	Riverboat Room, Lower Level
1:00 pm - 1:50 pm	MAA Student Activities Session: A Mathematical Tour of the State of the Planet	Monongahela, Theater 200
1:00 pm - 1:50 pm	MAA Student Activities Session: Connecting Digraphs and Determinants	Urban, Theater 400
2:00 pm - 3:55 pm	MAA Session #15	Conference B
2:00 pm - 3:55 pm	MAA Session #16	Conference C
2:00 pm - 3:55 pm	MAA Session #17	Carnegie III
2:00 pm - 3:55 pm	PME Session #7	Phipps
2:00 pm - 3:55 pm	PME Session #8	Oliver
4:00 pm - 6:15 pm	MAA Session #18	Conference B
4:00 pm - 6:15 pm	MAA Session #19	Conference C
4:00 pm - 6:15 pm	MAA Session #20	Carnegie III
6:00 pm - 7:45 pm	PME Banquet and Awards Ceremony	Urban Room
8:00 pm - 8:50 pm	J. Sutherland Frame Lecture	Grand Ballroom, Theater 900
9:00 pm - 10:00 pm	MAA Ice Cream Social and Awards	Monongahela Room

Saturday, August 7

Time:	Event:	Location:
9:00 am - 1:00 pm	Student Hospitality Center	Riverboat Room, Lower Level
9:00 am - 10:00 am	MAA Modeling (MCM) Winners	Urban Room
1:00 pm - 2:15 pm	Student Problem Solving Competition	Lawrence Welk Room

J. Sutherland Frame Lecture

INCOMPREHENSIBILITY

Nathaniel Dean
Texas State University

After data collection the analysis of complex systems is usually accomplished by analyzing the data using various statistical approaches. However, to understand the structural interactions between entities (for example, people, objects or groups), systems of interactions can be modeled as graphs linking nodes (entities) with edges that represent various types of relations between the entities. Then the graph can be visualized, explored and analyzed using a variety of mathematical algorithms and computer tools. In this talk we discuss the limitations of this approach, why some graphs cannot be visualized, and hence why certain data are visually incomprehensible.

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

FASTER, SAFER, HEALTHIER WITH OPERATIONS RESEARCH

Sommer Gentry
United States Naval Academy

While mathematical advances of all sorts have impacted our world for the better, operations research is a branch of mathematics that is expressly focused on applying advanced analytical methods to help make better decisions.

Operations researchers have eased traffic jams by closing selected streets, and gotten packages to you more quickly by planning U.P.S. routes with fewer left turns. Operations researchers have shown which personal decisions are the leading causes of death, and planned emergency responses for bioterror attacks and natural disasters.

Operations research can increase the supply of kidneys available for patients who need a transplant. In a kidney paired donation, one patient and his incompatible donor is matched with another patient and donor in the same situation for an organ exchange. Patient-donor pairs can be represented as the vertices of a graph, with an edge between two vertices if a paired donation is possible. A maximum matching on that graph is an arrangement in which the largest number of people can receive a transplant. Operations research techniques even proved the impact of paired donation on the kidney shortage, motivating Congress to pass a law allowing the United Network for Organ Sharing to arrange these transplants.

MAA Undergraduate Student Activities Sessions

A Mathematical Tour of the State of the Planet

Tom Pfaff
Ithaca College

Monongahela, Theater 200

Mathematics and mathematicians should play an important role in assisting society in understanding the major issues of our day. In this talk we will take a quantitative tour of the state of the planet. Some of the questions we will address are: How fast is the planet warming? What are the consequences of climate change? Should we be concerned about peak oil? Can China and the U.S. reach an agreement on carbon emissions? What will happen to maple syrup production in Ithaca, N.Y.? We dont always need big mathematical results to get insight into big problems. Sometimes all we need is some mathematical reasoning and undergraduate mathematical tools. In fact, some of the results we will see are from student projects.

Connecting Digraphs and Determinants

Jennifer Quinn
University of Washington Tacoma

Urban, Theater 400

"There is no problem in all mathematics that cannot be solved by direct counting."
–Ernst Mach
In linear algebra, you learned how to compute and interpret $n \times n$ determinants. Along the way, you likely encountered some interesting matrix identities involving beautiful patterns. Are these determinantal identities coincidental or is there something deeper involved? In this session, I will show you that determinants can be understood combinatorially by counting paths in well-chosen directed graphs. We will work to connect digraphs and determinants using two approaches:

- Given a "pretty" matrix, can we design a (possibly weighted) digraph that clearly visualizes its determinant?
- Given a "nice" directed graph, can we find an associated matrix and its determinant?

Previous knowledge of determinants is an advantage but not a necessity. This will be a hands-on session, so bring your colored pencils, your creativity, and be prepared to explore the mathematical connections.

MAA Student Speakers

Name	School	MAA Session
Samrachana Adhikari	Mount Holyoke College	13
Robert Allen	University of Texas at Arlington	15
Derek Allums	Texas A & M University	4
Razia Amzad	Pace University	4
Sam Anderson	Augustana College, Rock Island, IL	10
Benjamin Anderson	Arizona State University	8
Emily Anthony	University of Tennessee at Martin	2
Jeremy Anthony	Augsburg College	18
Taylor Asbury	Sam Houston State University	9
Kenneth Ascher	SUNY Stony Brook	4
Kassandra Averill	SUNY Potsdam	5
Hannah Blalock	North Georgia College and State University	10
Eric Bengfort	TWU Student	2
Dustin Brewer	University of Texas at Arlington	1
Scott Brothers	Duke University	3
Olivia Brozek	Marist College	5
Austin Buscher	United States Air Force Academy	7
Yuri Calustro	Longwood University	9
Yuying Cao	Emporia State University	5
Yuchen Chen	Emporia State University	5
Michelle Chu	Emory University	19
Renee Clarke	CUNY - New York City College of Technology	18
Lee Collins	Rowan University	14
Matthew Coudron	University of Minnesota	6
Thomas Crawford	Williams College	16
Amalia Culiuc	Mount Holyoke College	3
Amanda Curtis	Wellesley College	20
Jazmine Darden	Augsburg College	18
Stephanie Dilling	Augustana College	2
Christopher Dubbs	Lock Haven University of Pennsylvania	19
Clarice Dziak	Clarkson University	18
Samantha Erwin	Murray State University	11
Amelia Farid	Columbia University	7
Farjana Ferdousy	CUNY - New York City College of Technology	1
Morgan Fincher	Arkansas State University	13
Deborah Furr	North Georgia College and State University	10
Christina Grey	Sam Houston State University	8
Matthew Griisser	North Georgia College and State University	10
Kevin Groat	University of Mary Washington	15
Nancy Gullo	Dominican University	4
Ronald Hatt	Penn State Erie, The Behrend College	3
Zachary Hodge	Austin Peay State University	15

MAA Student Speakers (Continued)

Name	School	MAA Session
Andreana Holowatyj	Benedictine University	19
Andrew Hosie	Edinboro University of Pennsylvania	11
Jesse Hotchkin	Austin Peay State University	15
Dennis Howell	Towson University	15
Aron Huckaba	Murray State University	5
Nick Hudson	Augsburg College	18
Daniel Huston	Mount Union College	14
Nghiep Huynh	Augsburg College	18
Joshua Ide	Shippensburg University	12
Jonathan Inselman	Winona State University	9
Ibrahim Jadoon	Centre College	3
Peter Jantsch	Grove City College	17
Stephanie Jensen	Williams College	16
Ann Johnston	Harvey Mudd College	5
Kimberly Kaplan	Chatham University	1
Maryam Karnib	Wayne State University	3
Josh Keilman	Calvin College	20
Jennifer Kile	Marist College	15
Mary Kimberly	Denison University	7
Katelynn Kochalski	Canisius College	20
Christopher Lemon	Clarkson University	16
Brian Leventhal	Clarkson University	8
Jonathan Li	UC Irvine and St. Margaret's Episcopal School	11
Yifei Li	Berea College	14
Richard Ligo	Westminster College	10
Joseph Lombardi	Marist College	5
Steven Lora	City University of New York	18
Joan Madsen	Brigham Young University	20
Andrew Makepeace	Penn State University	1
Laura Maki	Winona State University	9
Declan Mallamo	Seattle Central Community College	19
Michael Mara	Williams College	17
Gary Marple	Colorado State University-Pueblo	7
Jonathan Martin	Purdue University	4
Elizabeth McCaslin	McDaniel College	12
Bryan McCauley	Winona State University	10
Casey McKnight	Austin Peay State University	15
Rachel Messick	Brigham Young University	20
Tabitha Michael	Austin Peay State University	2
Sara Miller	Towson University	15

MAA Student Speakers (Continued)

Name	School	MAA Session
Brandon Milonovich	The College of Saint Rose	9
Mark Minick	Clarkson University	18
Andrew Mis	Calvin College	20
Rachel Moger-Reischer	Bucknell University	4
Charles Morrissey	Michigan State University	13
Angelina Myers	Dominican University	2
Nakisa Nassersharif	Syracuse University	19
Ashley Nelson	Emory & Henry College	14
Liem Nguyen	University of Wisconsin, Oshkosh	12
Zhaoqun Niu	Seattle Central CC	13
Amber O'Connell	Austin Peay State University	15
Edward Ohanian	Marist College	5
Nicholas Owad	Kutztown University	10
Nana Owusu	Augsburg College	18
Megan Padula	Chatham University	1
Youngmin Park	Case Western Reserve University	11
Brad Pearson	Westmont College	3
Raymond Perkins	Morehouse College	10
Thanh-Hoa Pham	University of Louisiana at Lafayette	20
Andrew Pfeiffer	North Georgia State and Collge University	10
Beidi Qiang	Denison University	7
Paul Read	Purdue University Calumet	11
Joshua Ritter	Michigan State University	10
Benjamin Ritz	Clarkson University	8
Garrett Rodriguez	Alma College	10
Marie Rogers	Clarkson University	16
Larry Rolen	UW Madison	12
Isamar Rosa	University of Puerto Rico, Mayaguez	14
Sebastian Sanchez	New Mexico State University	17
Gregory Schwartz	Franklin & Marshall College	11
Luke Serafin	Coe College	20
Jacob Shapiro	Denison University	19
Evan Shirley	Centre College	3
Kyler Siegel	Columbia University	16
Benjamin Simmons	St. Olaf College	6
Justin Sims	University of Tennessee at Martin	2
Doug Smith	Grove City College	17
Lauren Smith	Oklahoma State University	14
Andrew Snyder-Beattie	University of Mary Washington	15
Ryan Spitler	Alma College	13
Mary Spuches	St. Michael's College	8
Faye Stevens	Mount Holyoke College	7
George Story	Wake Forest University	8

MAA Student Speakers (Continued)

Name	School	MAA Session
Glenn Sutula	Denison University	6
Ruth Swift	Hastings College	4
Anjali Taneja	Boston University	12
Ashley Toth	Rollins College	20
Brandon Tries	Salem State College	17
Jonathon Verwys	Grand Valley State University	17
Ryan Viertel	Brigham Young University	17
Melanie Vining	Coastal Carolina University	20
Philip Vu	Williams College	6
Fenghao Wang	McDaniel College	12
Bjorn Wastvedt	St. Olaf College	12
Jonathan Watson	University of Michigan	17
Stephen Webster	Williams College	9
Jakob Weisblat	John Carroll University	9
Jonathan Weisbrod	Rowan University	17
David Whitaker	North Georgia College and State University	10
Elena Wikner	Williams College	14
Robin Wilke	University of Vermont	18
Jamie Woelk	Western State College	7
Jared Wolf	Arkansas State University - Jonesboro	1
Ka Hei Kathleen Wong	Winona State University	13
Jodi-Ann Young	CUNY - New York City College of Technology	18
Jiawen Yu	CUNY - New York City College of Technology	18
YiMing Yu	CUNY - New York City College of Technology	18
Nathaniel Zakahi	Denison University	6
Klavdia Zemlianova	Cal Tech and McQueen High School	6
Liyang Zhang	Williams College	16
David Zitelli	USAF Academy	11

Pi Mu Epsilon Speakers

Name	School	Chapter	PME Session
Matt Alexander	Youngstown State University	OH Xi	2
Dylan Asmar	United States Air Force Academy	CO Gamma	6
Neal Barcelo	Denison University	OH Iota	2
Jessalyn Bolkema	Hope College	MI Delta	7
Xinru Cai	Mount Union College	OH Omicron	2
Haoqi Chen	St. Norbert College	WI Delta	1
Danielle Chomic	Pepperdine University	CA Xi	3
Lisa Curll	Youngstown State University	OH Xi	5
David Daniels	Western Oregon University	OR Delta	5
Thomas Eliot	Willamette University	OR Zeta	8
Melissa Emory	University of Nebraska at Omaha	NE Gamma	1
Erica Evans	Denison University	OH Iota	8
Richard Freedman	Wake Forest University	NC Lambda	1
Xiaojing Fu	Clarkson University	NY Omicron	2
Jennifer Garbett	Kenyon College	OH Pi	5
Kevin Gerstle	Kenyon College	OH Pi	7
Alexander Golec	Fordham University	NY Alpha-Nu	2
Nathan Graber	Hope College	MI Delta	7
Tyler Hardgrove	Youngstown State University	OH Xi	5
Anthony Harrison	Texas State University	TX Rho	4
Bryan Hong	William Paterson University	NJ Lambda	3
Michael Joseph	John Carroll University	OH Lambda	8
Darlena Kern	Pepperdine University	CA Xi	3
Sepideh Khavari	Youngstown State University	OH Xi	5
Kyle Kloster	Fordham University	NY Alpha-Nu	3
Josh Koslosky	Duquesne University	PA Upsilon	3
James Manning	University of South Carolina	SC Alpha	3
Tara McCart	Youngstown State University	OH Xi	6
Chelsea Miedema	Hope College	MI Delta	6
Josh Mike	Youngstown State University	OH Xi	5
Kelley Moran	Goucher College	MD Theta	5
Alexander Murray	SUNY Potsdam	NY Phi	8
Robert Nash	Hope College	MI Delta	6
Charles Nguyen	University of Texas at Arlington	TX Iota	3
Nicholas Noblett	Siena College	NY Alpha-Epsilon	6
Ryan Northrup	Clarkson University	NY Omicron	7
Joseph Paat	Denison University	OH Iota	8
Bryce Pioske	Denison University	OH Iota	2
Kayla Pope	St. Norbert College	WI Delta	5
Scott Powers	University of North Carolina at Chapel Hill	NC Beta	6

Pi Mu Epsilon Delegates (Continued)

Name	School	Chapter	PME Session
Kristin Reinsvold	College of St. Benedict and St. Johns University	MN Delta	4
Christopher Schafhauser	University of Wisconsin - Platteville	WI Eta	7
Teresa Schermerhorn	Ashland University	OH Rho	4
Bradley Slabe	Youngstown State University	OH Xi	1
Allison Spencer	SUNY Fredonia	NY Pi	4
Mario Sracic	Youngstown State University	OH Xi	7
Mitch Staehle	Western Oregon University	OR Delta	4
Hannah Stanton	University of Montana	MT Alpha	5
Kaylee Sutton	John Carroll University	OH Lambda	8
Drew Tillis	Hendrix College	AR Beta	1
Lindsay Van Leir	Roanoke College	VA Delta	4
Manasi Vartak	Worcester Polytechnic Institute	MA Alpha	6
Corey Vorland	St. Norbert College	WI Delta	4
Julia Warnke	University of Nebraska at Omaha	NE Gamma	6
Alexander White	Pepperdine University	CA Xi	3
Moriah Wright	Youngstown State University	OH Xi	1
Randi Yazvac	Youngstown State University	OH Xi	6
Yan Zhuang	Goucher College	MD Theta	5

Delegates

Name	School	Chapter
Kassandra Averill	SUNY Potsdam	NY Phi
Gary Engler	William Paterson University of New Jersey	NJ Lambda
David Kent	Case Western Reserve University	OH Sigma
Grace McClurkin	Saint Mary's College	IN Epsilon
Michael Nachtigal	University of South Florida	FL Epsilon
Crystal Peoples	Longwood University	VA Epsilon

MAA Session #1

Room: Conference B **8:30A.M. – 10:25A.M.**

8:30–8:45

Study of Nosocomial Infection in Brooklyn, NY- a SENCERIZED Project

Farjana Ferdousy
NYCCT, CUNY

Antibacterial resistance is an emerging problem in many bacterial infections and in particular, in NI infections. With the increased levels of antibiotic usage among humans, livestock, and crops, antibiotic resistance bacteria increased dramatically in past few years. In this project, we studied three of the most common pathogens responsible for NI infections: Klebsiella, Pseudomonas, and Acinetobacter. Single patient isolates were collected from fifteen different hospitals in Brooklyn during a three-month period in 2006 [for further information please consult: JAC 2007; 60:78-82]. Susceptibility and resistance to five of the most important antibiotics are studied. The antibiotics that we studied here are as follows: amikacin, ceftazidime, piperacillin-tazobactam, ciprofloxacin, and imipenem. We assumed our null hypothesis as no association exist between different Brooklyn hospitals and susceptibility rates to these five antibiotics. A chi-squared test revealed that there exist association among different hospitals and antibiotic resistance with some exceptions. Now the question that we need to answer is as follows: what are the underlying causes of these differences?

8:50–9:05

FDTD-FEM Hybrid Approach: 2D Cavity Problem

Kimberly Kaplan and Megan Padula
Chatham University

This paper involves the computation of electromagnetic fields scattered by a cavity in a ground plane. We are working in a Two-Dimensional setting where we compute solutions of Maxwell's equations using a finite difference time domain - finite element method hybrid approach (FDTD-FEM). This talk focuses on the FDTD portion which models the space outside the cavity including plane waves. The FDTD portion is joined with the FEM solution to get a complete solution of the scattered fields.

9:10–9:25

The Motion of Particles with Complementarity Conditions

Jared Wolf
Arkansas State University - Jonesboro

In this work, we consider a moving particle which drops down onto a stationary rigid foundation and bounces off after its impact. Based on Newton's laws, this dynamic contact problem is formulated by the following second ordinary differential equation:

$$\frac{d^2u}{dt^2} = f(t) + N(t).$$

The contact conditions which are described by the complementarity conditions are also included in the dyanmic contact problem. The initial displacement and velocity are given. In the previous papers of dynamic contact problems, mostly the weak formulations have been set up in terms of only solutions of the displacement $u(t)$, removing the contact forces $N(t)$ from the original formulation. However, the new approach by Jeongho Ahn and David E. Stewart enables us to keep the contact forces as a part of the complementarity conditions, making it possible to consider the existence of solutions to both the displacement $u(t)$ and the contact forces $N(t)$. We use natural cubic splines to show the existence of a solution in the strong sense and use Laplace transforms to show conservation of energy. Applying time discretization and the implicit Euler method, numerical formulations are established and the numerical results are presenthted. Our main goal as we continue working on this project is to prove the existence of solutions and the uniqueness of solutions.

9:30–9:45

Computational Techniques for a One-Dimensional Magnetostatic Plasma Simulation

Dustin Brewer
University of Texas at Arlington

The electromagnetic behavior of a plasma is described by a system of partial differential equations known as the "Vlasov-Maxwell" system. From a mathematical standpoint, very little is known about the physically-accurate three-dimensional system, but a one-dimensional magnetostatic adaptation of the equations can be studied much more easily. Knowledge of the dynamics of solutions to this reduced system, which computer simulation can help to determine, would be useful in predicting the behavior of the unabridged Vlasov-Maxwell equations. We will both describe and provide an analysis (in terms of efficiency and accuracy) of some computational techniques for approximating solutions, including numerical finite-difference approximations and particle-in-cell methods.

9:50–10:05

Single Direction Forcing In Spring Mass Systems

Andrew Makepeace
Penn State University

Spring mass systems, described by the differential equation $my'' + by' + ky = F(t)$, where m, b, and k are constants and $F(t)$ is a forcing funcion, are widely studied for their practicality, and much is known about systems forced in traditional manners. In this work, we consider a system that can only be forced in one direction, that is, for example, $F(t) \geq 0$ for all t. We compute the resonance frequencies for various classes of positive functions (e.g. positive square waves and half-rectified sine curves). Next, we seek the best class of forcing functions that maximizes the response in the steady state for both amplitude and RMS power, for given maximum input amplitude and RMS power.

10:10–10:25

Tiling the Plane with Convex Equilateral Pentagons

Lauren Smith
Oklahoma State University

This talk will begin with a brief look at the history of monohedral tilings with convex polygons. Next it will delve into tiling the plane with equilateral pentagons and introduce a pentagonal tiling with an equilateral pentagon. A proof that the pentagonal tiling tiles the plane with no gaps or overlaps is included in this portion of the talk. This speech will conclude with a demonstration of original artwork that was inspired by the pentagonal tiling.

MAA Session #2

Room: Conference C **8:30A.M. – 10:25A.M.**

8:30–8:45

Lies, Damn Lies, and Statistics: Statistical Literacy in Secondary Education

Stephanie Dilling
Augustana College

Statistical Literacy is a crucial but often overlooked component in the traditional mathematics curriculum at the secondary level. This presentation will describe what statistical literacy is and why it is important for students to develop. In this presentation, examples of common problems in the day-to-day use of statistics and graphs will be presented. Resources for educators, especially those in the field of secondary education, will be offered as well.

8:50–9:05

Developmental Mathematics Through the Centuries

Tabitha Michael
Austin Peay State University

Developmental education has spanned the centuries in areas of English, reading, and mathematics. Ivy League schools were among the first universities to offer developmental courses and programs. The increase of access to higher education is a major contributing factor to the need for academic support structures. While journeying through the centuries, this paper traces the beginning of developmental mathematics and its evolution.

9:10–9:25

A Construction Algorithm for Lattice Polygons of Specified Genus

Robin Wilke
University of Vermont

How many unique lattice polygons are there with three interior points? The answer is ... God knows! Finding the number of nonisomorphic two-dimensional convex lattice polygons with a specified number of interior points i is surprisingly hard: the number of inequivalent polygons with $i = 1$ was under dispute for several decades, and finding the exact complete set of inequivalent polygons with $i \geq 2$ is still an open problem. The methods used to find these polygons thus far have been based on number of sides, proving properties that n-gons with one interior point must have to try and whittle down the number of n-gons that would need to be checked for equivalence, and then brute-force checking them, using a different class of theorems for each n. We propose a new way to construct a complete set of lattice inequivalent polygons for any i, based on the relative minimality or maximality of polygons instead of the number of sides, and demonstrate it for $i = 1$ and $i = 2$. The algorithm presented allows insight into which polygons can be generated from which other polygons, inducing a directed graph structure into any set of inequivalent polygons for a value of i. Some combinatorial properties of these graphs will also be discussed. Finally, we discuss applications to cryptography, the theory of modular forms, and several problems in computational geometry.

9:30–9:45

Exploring Placement Criteria in Undergraduate Mathematics Courses

Justin Sims and Emily Anthony

University of Tennessee at Martin

One major obstacle in correctly placing freshmen and sophomore undergraduate students in mathematics courses is deciding a standard that ensures the highest probability of success. Currently the University of Tennessee at Martin places students solely based upon their scores on the mathematics portion of the ACT Exam using cutoffs based on previous studies at the university. In this paper, we analyzed the success rate of the current placement model and explored various regression and generalized linear models and determined the best model which produced the highest probability of success.

9:50–10:05

Exploring Fractal Dimension Through the Analysis of Common Fractals

Angelina Myers

Dominican University

Fractals, such as the Sierpinski Triangle, can be created using a mathematical algorithm known as the Chaos Game. Altering the Chaos Game will not only change the image that is created but will also change the figure's fractal dimension. This paper will show how changing the parameters of the Chaos Game such as the number of fixed points, the scaling ratio, and the degree of rotation, impacts fractal dimension. As an introduction, a thorough analysis of the Sierpinski Triangle will be provided along with an explanation of fractal dimension and the procedure of the Chaos Game. Following this there will be a discussion of the methods and results of experiments performed to investigate fractal dimension.

10:10–10:25

Simulating Entity Behavior using Bayesian Statistics

Eric Bengfort

Texas Woman's University

Bayesian Learning is a machine learning classification algorithm. Given a set of objects, each described by a vector of features, the algorithm attempts to "learn" how to separate distinct objects into appropriate categories or classes. The inputs to the very first algorithm coded were a list of known poisonous/non-poisonous mushrooms and a description of what each mushroom looks like. The coded Bayesian Learning program successfully classified all unknown mushrooms into the correct poisonous/non-poisonous class. The principal investigator then extended the code to include decision-making of an artificially intelligent entity. The simulation results were highly satisfactory. The next goal is to disseminate these results via an undergraduate mathematics journal. Two of these ideal journals are: The American Mathematical Monthly or The College Mathematics Journal published the Mathematical Association of America. I presented these research findings at the NTASC'10 at MSU on April 10, 2010.

MAA Session #3

Room: Phipps **8:30A.M. – 10:25A.M.**

8:30–8:45

Rings of continuous functions, $C(X)$ and $C(X,Z)$

Ronald Hatt

Penn State Erie, The Behrend College

In this talk I will give the topological definition of continuous functions and talk about the ring structure of the collection of all the real-valued continuous functions, $C(X)$. Furthermore, I will generalize the concept to the collection of all integer-valued continuous functions, $C(X,Z)$, and compare these two rings. I will provide several examples and results concerning the two rings $C(X)$ and $C(X,Z)$.

8:50–9:05

Can You Hear Me Now?

Evan Shirley

Centre College

This is a question asked by many cell phone users today. In this talk we use topological data analysis (TDA) to answer this question. TDA is a new mathematical method developed in the last decade to count the number of "holes" in a data set. This number is called the Betti number of a point cloud. We will use this concept in an algorithm to determine whether a coverage area is actually covered.

9:10–9:25

Lengths of Piecewise Linear Spirals

Scott Brothers

Duke University

We examine the properties of certain classes of piecewise linear spirals in $\mathbb{R}^n$. We demonstrate how the spirals are constructed by using convex combinations of points in $\mathbb{R}^n$. In particular, we provide formulas for the length of such spirals under various assumptions.

9:30–9:45

Limiting Behaviors of Piecewise Linear Spirals

Brad Pearson

Westmont College

We generate piecewise linear spirals in $\mathbb{R}^n$ using linear difference equations. We provide conditions under which the spirals are contained in a 2-dimensional subspace. We examine the limiting behavior of the spirals under various assumptions.

9:50–10:05

Most Sums are Gosperable

Maryam Karnib
Wayne State University

The problem of finding closed-form expressions of hypergeometric sums was revolutionized by its computerization through Gosper's algorithm. In this talk, we describe how closed-form expressions for hypergeometric sums can be efficiently and elegantly handled by the computer. We also show various practical applications of the algorithm.

10:10–10:25

A Numerical Analysis of the Non-Self-Adjoint Harmonic Oscillator

Amalia Culiuc
Mount Holyoke College

We investigate numerically the spectral properties of the Non-Self-Adjoint Harmonic Oscillator. In particular, we describe the pseudospectra of this operator.

MAA Session #4

Room: Oliver **8:30A.M. – 10:25A.M.**

8:30–8:45

Zeno's Paradoxes

Jonathan Martin
Purdue University

Zeno of Elea believed that everything was one, and that motion and change were merely illusions. As such, he thought of several scenarios to demonstrate the absurdity of motion. In this talk, we will examine a few of Zeno's most well-known paradoxes and try to explain them in both a mathematical and a philosophical light.

8:50–9:05

Rook Polynomials in Higher Dimensions

Rachel Moger-Reischer and Ruth Swift
Bucknell University and Hastings College

A rook polynomial counts the placements of non-attacking rooks on a board. In two dimensions, a board is a collection of tiles arranged in rows and columns. Equivalently, a board is a collection of pairs of integers representing the tiles. A rook placed on a cell can attack any other cell in the same row or column. These polynomials can be used to represent a variety of combinatorial problems including permutations with restrictions and matching problems. It is possible to generalize rook polynomials to dimensions higher than two by letting boards consist of d-tuples, where d is the dimension, and by letting rooks attack along hyperplanes. Properties of rook polynomials in two dimensions generalize readily to higher dimensions. Moreover, there are families of boards in two dimensions whose rook numbers are directly calculable and correspond to famous number sequences. In this talk, we present our research on generalizing these two-dimensional families to higher dimensions. This work was completed at the 2010 REU program at Grand Valley State University.

9:10–9:25

Exploring Semigroups

Nancy Gullo
Dominican University

This presentation will focus on semigroup theory, a relatively new branch of mathematics. A semigroup is an algebraic structure that results from removing the identity and invertibility axioms from the group structure. In this presentation, we will define a semigroup and other introductory terms associated with semigroup theory. Besides providing formal definitions of each of these structures, we will discuss examples that illustrate these concepts. From there, we will discuss an application of semigroup theory: the Sierpinski triangle. The Sierpinski triangle is the fractal that results from repeatedly subdividing and deleting portions of the equilateral triangle. Informally, a partial symmetry of this structure is a bijection from part of the structure to another. The set S of all partial symmetries forms a semigroup. The set R that contains the translational symmetries and rescaling transformations is a submonoid.

9:30–9:45

The Rank Gradient and the Lamplighter Group

Derek Allums
Texas A & M University

For non-amenable groups, the rank gradient - the ratio of the minimal number of generators of a subgroup $H < G$ to its index in G - of a sequence of subgroups of finite index grows linearly with respect to the index. Its behavior is completely unknown for the amenable groups except for the classic fact that it is uniformly bounded for polycyclic groups. We show that for solvable groups the asymptote of the rank gradient may depend on the index differently for distinct descending chains of subgroups of finite index. We illustrate this with the Lamplighter group which is the wreath product of the group of order two and infinite cyclic group. We also provide some information on the structure of the lattice of subgroups of primary index a power of 2 in the Lamplighter group and use the realization of the Lamplighter group as a group generated by two state automaton over an alphabet on two letters used by R. Grigorchuk, V. Nekrashevych and other mathematicians on studies around the Atiyah Conjecture, scale invariant subgroups and other topics.

9:50–10:05

Systems of Polynomial Equations: Algorithms and Applications

Kenneth Ascher
SUNY Stony Brook

We study polynomial system solving algorithms, with an eye toward applications in biology. By employing recent chamber-based homotopy methods, we see interesting speed-upsover certain commutative algebra methods for solving equations that actually occur in practice. This project arose from my work in Prof. Rojas' 2010 summer REU at Texas A&M University.

10:10–10:25

Unbreakable Codes

Razia Amzad
Pace University

Public Key Cryptosystems uses encoding keys that are the form of modulus m and the exponent k which can be distributed to the public while the decoding method remains secure. Public Key Cryptosystems are also known as RSA coding, which are used often because the internet runs on open networks. Public Key Cryptosystems are used with open systems mainly because there are higher risks than with older forms of e-commerce that run on closed networks such as electronic data interchange (EDI) or electronic fund transfer (EFT). Open networks create a variety of security challenges such as the integrity of the information being transmitted, the confidentiality of private or personal information, the authenticity of the communicating parties, and the assurance that the communicating parties have the authority to enter into the transactions. Public Key Cryptosystems allow secure internet transactions by providing authentication, confidentiality, digital signatures, data integrity, and non-repudiation, which prevents the receiver of a message from denying that the message had been received. Cryptography plays an essential role in protecting the privacy of electronic information against threats from a variety of potential attackers. The purpose of this presentation is to comprehend the evolution of codes and ciphers along with understanding how to encode and decode a message using RSA coding. In this PowerPoint presentation "Unbreakable Codes" we will highlight the historical advances of communicating secure messages, by illustrating the process of RSA coding with an example.

MAA Session #5

Room: Carnegie III **8:30A.M. – 10:25A.M.**

8:30–8:45

Stuck in the Middle and Noncommutative

Ann Johnston and Kassandra Averill
Harvey Mudd College and SUNY Potsdam

In calculus, real-valued continuous functions are studied extensively, while for many analysts the main objects of consideration are complex-valued continuous functions. The spaces of these functions are both well-understood, since the codomains of their elements are fields. On the other hand, quaternion-valued continuous functions exhibit quite different behavior from the complex and real cases, due to the noncommutativity of quaternion multiplication. There is a straightforward complete characterization of the full algebra of quaternion-valued continuous functions, and we extend this to a characterization of particular subalgebras that contain quaternion-valued Lipschitz functions. The Lipschitz property of functions is weaker than differentiability and stronger than continuity, making such spaces interesting objects to consider.

8:50–9:05

Using SIR Equations to Model the Spread of Influenza A H1N1

Yuchen Chen and Yuying Cao
Emporia State University

Influenza A (H1N1) is well known as swine flu that broke out in April 2009 and spread throughout the world rapidly. Studying the progress of H1N1 can be significant. Kermack-McKendrick SIR model (1927) is one of the most basic models helping visualize the progress of epidemics in a large population. Based on the understanding of the SIR model, our reasearch investigated two essential parameters of it (the recovery rate and basic reproduction number) for H1N1 case. Moreover, we focused on using the model to simulate the spread of H1N1 in different regions in the U.S.

9:10–9:25

From Bernoulli to Beckham: The Eradication of Smallpox and Polio

Edward Ohanian
Marist College

Eighteenth-century mathematician Daniel Bernoulli introduced the notion of compartmental models in mathematical epidemiology in his work on the dreaded smallpox virus. Some 200 years later, smallpox was declared dead in a spectacular scientific triumph which would lengthen and improve the lives of millions worldwide. Despite advances in all aspects of the science, this success has proven unique in the fight against global viral epidemics. In this talk, we will qualitatively analyze the dynamics of the smallpox virus, and address how this analysis can provide insight into control strategies in the current world initiative to eradicate polio.

9:30–9:45

Challenges in the Mathematical Modeling of Cholera

Joseph Lombardi
Marist College

The Susceptible-Infected-Susceptible (SIS) model in mathematical epidemiology has proven to be a significant and effective predictive tool in describing the dynamics of bacterial diseases. In all but the most rudimentary models, some degree of uncertainty in parameters must be expected as inescapable. In this talk, we will focus on the dynamics of endemic cholera. It will be our attempt to quantify the uncertainty introduced in the model created for cholera, and analyze the degree to which this uncertainty ultimately propagates throughout the model.

9:50–10:05

Modeling Uncertainty in Marburg Hemorrhagic Fever

Olivia Brozek
Marist College

Marburg hemorrhagic fever is a deadly, viral disease first manifested forty years ago. Traditional SIR (Susceptible-Infectious-Removed) models used to study epidemic dynamics have proved inadequate to fully address the large degree of uncertainty inherent in data on this rare disease. In this talk, we combine elements from earlier successful epidemiological models to better describe dynamics of this disease.

10:10–10:25

Correlation and Cluster Analysis in Epidemiology

Aron Huckaba
Murray State University

Networks help explain relationships between sets of data, such as spatial and numerical data. The Center for Disease Control records data based on influenza outbreaks in the United States, with varying degrees of detail. Constructing a network of the United States based on relationships within the reported data can help explain the mechanism of transport for epidemics, important regions of the country in regard to the disease's spread, and other relevant epidemiological topics. Some clustering techniques analysis of data using constructed clusters will be discussed, as well as useful conclusions and possible suggestions for future outbreaks of H1N1.

MAA Session #21

Room: Three Rivers **8:30A.M. – 10:25A.M.**

Abstracts received too late to appear in print.
Please refer to the MAA Student web page at:
`http://www.maa.org/mathfest/students.cfm`
for presenters' names, talk titles, and abstracts.

MAA Session #6

Room: Conference B **2:00P.M. – 3:55P.M.**

2:00–2:15

Modular Tableaux and Their Conjugates

Benjamin Simmons
St. Olaf College

We provide a brief introduction to partition theory and the closely related field of tableau theory. We focus specifically on modular tableaux, defined by Garrett and Killpatrick as follows: a tableau is modular if, for some k, a, $b \in \mathbb{Z}$, any given cell in row i and column j (with columns increasing from left to right and rows increasing from top to bottom) has content $ai + bj \mod k$. We offer and prove a theorem linking modular tableaux and their conjugates, and we demonstrate the usefulness of this result in counting modular tableaux.

2:20–2:35

The Norm of the Resolvent of a Square Matrix

Philip Vu
Williams College

We investigate the norms of resolvents of a normal or non-normal square matrix A. We estimate the norm of $A - zI$ in terms of the distance from z to the spectrum of A.

2:40–2:55

Norm Characterizations of Operator Algebras

Nathaniel Zakahi
Denison University

Two unital matrix algebras are isomorphic only if completely isometric: their algebraic structure is determined by their linear and norm structure. But when is a unital subspace of $N \times N$ matrices completely isometric to a matrix algebra, and can we characterize this in terms of matrix norms? This talk offers an investigation of this question and attempts to characterize algebraic definitions, such as normality, in terms of matrix norms.

3:00–3:15

Adjacency Matrices and their Connections to Error Correction

Glenn Sutula
Denison University

A linear code, V, is a left-invertible $k \times n$ matrix which encodes vectors in $\mathbb{R}^n$ or $\mathbb{C}^n$ by matrix multiplication. It is know that length-preserving linear codes are in one-to-one correspondence with projections. In this case, V*V=I, and VV* is the set projection. Many of the projections of interest arise as spectral projections of the adjacency matrices of graphs and hypergraphs. In this talk, we will give results connecting certain classes of graphs to especially desirable linear codes, particularly those which are effective for error correction. This talk will focus primarily on linear codes in $\mathbb{R}^n$, though if time permits, we will consider complex codes and their connections with directed graphs.

3:20–3:35

The Distribution of Eigenvalues of the Non-Hermitian Anderson Operators

Matthew Coudron

University of Minnesota / SMALL Program at Williams College

The spectrum of a Non-Hermitian Anderson operator consists of real eigenvalues and complex eigenvalues on smooth curves in the complex plane. We study the spacings between nearest eigenvalues: for eigenvalues on the real line we obtain Poisson statistics; for complex eigenvalues, we see a transition towards the picket-fence distribution.

3:40–3:55

From Verhoeff Error Detection to Complete Error Correction

Klavdia Zemlianova

Cal Tech and McQueen High School

In 1969, J. Verhoeff developed an identification number error detection scheme that is based on a permutation in S_{10}. Although his scheme is superior to many others, it still is limited to only guaranteed detection of transposition and single digit errors. We have found permutations that are the best at detecting each of the following errors: single, transposition, twin, jump, twin jump and phonetic and combined them into one scheme. By using multiple permutations each of which specializes in these various types of errors, we have produced a scheme which improves the Verhoeff scheme from error detecting to error correcting.

MAA Session #7

Room: Conference C **2:00P.M. – 3:55P.M.**

2:00–2:15

Approximating Functions with the Binomial Theorem

Austin Buscher
United States Air Force Academy

The binomial theorem has applications in a wide variety of mathematical arenas. We will examine how the generalized binomial theorem can be used to approximate roots of natural numbers, trigonometric functions and the exponential function. Further, we will examine error and convergence in these approximations and show how they relate to other numerical methods for approximating functions.

2:20–2:35

Proofs Outside the Box! Combinatorial Proofs of Certain Identities

Amelia Farid
Columbia University

Don't prove your combinatorial identities the tedious way! In this talk we discuss combinatorial proofs - a simple and elegant method of proving combinatorial identities -and prove certain interesting identities.

2:40–2:55

Proving Combinatorial Identities using the Wilf-Zeilberger Approach

Gary Marple
Colorado State University - Pueblo

In the early nineties Herbert Wilf and Doron Zeilberger discovered that the search, evaluation, and proof of certain combinatorial sums and identities can be done by the computer. In this talk we will explore and highlight the Wilf-Zeilberger (WZ) methods and show various practical applications of the methods in combinatorics.

3:00–3:15

A Combinatorial Exploration of a Kostka Matrix Identity for Partitions of Integers ≤ 5

Mary Kimberly
Denison University

Sagan and Lee (2006) provided a combinatorial proof for the last column of $K^{-1}K = I$, where K is the Kostka matrix and I is the identity matrix. In this talk we provide a combinatorial proof for the identity $K^{-1}K = I$ for partitions of integers less and or equal to 5 using a sign reversing involution.

3:20–3:35

A Combinatorial Expoloration of a Kostka Matrix Identity for Partitions of Integers ≥ 5

Beidi Qiang

Denison University

Sagan and Lee (2006) provided a combinatorial proof for the last column of $K^{-1}K = I$, where K is the Kostka matrix and I is the identity matrix. In this talk we provide a combinatorial proof for the identity $K^{-1}K = I$ for partitions of integers of size 6, and explore the more general case.

3:40–3:55

Rank Disequilibrium in Multiple-Criteria Evaluation Schemes

Faye Stevens and Jamie Woelk

Mount Holyoke College and Western State College

Researchers in the field of conflict resolution have coined the phrase "rank disequilibrium" to refer to situations in which "there are multiple criteria for assessing people's merit or contributions, and some people are higher on one criterion and lower on another criterion than others." Rank disequilibrium is known to be a significant cause of organizational conflict, in large part due to self-serving biases that cause evaluees to view the criteria in which their performance is strongest as more significant or relevant to the overall evaluation than other criteria. As a result, it is possible for each individual in an organization to feel more deserving of rewards than others, which can lead to perceptions of inequity when evaluations are made known. In this talk, we will present a mathematical model of rank disequilibrium that incorporates aspects of traditional Arrovian social choice theory as well as recent research on the separability problem in referendum elections. Through this model, we will explore desirable properties of evaluation schemes and consider ways in which perceived inequity may be avoided. This research was completed as part of the summer mathematics REU program at Grand Valley State University.

MAA Session #8

Room: Carnegie III **2:00P.M. – 3:55P.M.**

2:00–2:15

Design Optimizations for DNA Nanostructures

Mary Spuches
St. Michael's College

We use graph theory, combinatorics, algebra and geometry to minimize the cost of self-assembling DNA nanostructures. We first demonstrate that the octet truss provides an accurate geometric framework for current branched junction molecule assembly methods. These branched junction molecules, called tiles, have arms that represent double strands of DNA. We then develop a method of differentiating among tiles, the basic building blocks of the nanostructures themselves, within this structure. We determine the possibilities using only a single type of either a two or a four armed tile, and then the possibilities using (necessarily) two types of three armed tiles. This list of constructions, which include several Platonic and Archimedean solids, will provide useful information in the constructions of DNA nanostructures in order to guarantee the greatest level of efficiency. We also present an algorithm, written in Java, with the purpose of finding each unique tile in its lexicographically minimal representation. Along with the program, we present a proof to demonstrate that the operations performed by the program on the individual tiles are valid and cover each member of the symmetry group of the cuboctahedron. We use these figures as model graphs to determine optimal design strategies for biologists producing these graphical nanostructures.

2:20–2:35

A New Look at a Consensus Problem in SO(3)

Benjamin Anderson
Arizona State University

Basic consensus problems are to design control laws that make the collection of all agents perform tasks. Such tasks include meeting at a point, assuming a specific configuration, orienting themselves in a specific way, etc. Motivated by the control of swarms and networks of autonomous agents, we use MATLAB to visualize a new type of consensus problem in SO(3). In most cases, as in the problem of birds flocking or fish swarming, autonomous agents use information of immediate neighbors to determine the best course of consensus. In our consensus problem, the information that is used to come to consensus is an orientation in 3-space, along with the orientations of immediate neighbors. The preparatory work presented here considers a set of agents with fixed locations along a circle. Their states are their orientations in 3-space. Each agent communicates only with its immediate neighbors. We analyze and visually demonstrate the constraints on tasks such as achieving consensus on orientation imparted by the nontrivial topology of the rotation group SO(3).

2:40–2:55

A Species-specific Model for Computing the Volume and Surface Area of Snakes

Christina Grey
Sam Houston State University

Biologists would like to know the volume and surface area of a snake for many reasons, including pharmaceutical dosing. Procedures used in finding these measurements, however, range from difficult (volume) to almost impossible (surface area). We have developed a species-specific model that calculates these values to a very high precision.

3:00–3:15

Traffic Flow Modeling: Traffic Jams, Highway Design, and More

George Story
Wake Forest University

Traffic flow is a relevant topic in mathematics with many practical applications. A rapidly growing population means more drivers on the road. Thus, the need for efficient road design is apparent. Luckily, traffic flow readily lends itself to modeling. In this talk, we will focus on a discrete model realized using Microsoft Excel. This simple model can be modified for many situations. We will first explore the formation and workings of traffic jams in single lane situations. We will then explore the possible benefits of adding a tollbooth in areas of high traffic density and other similar scenarios.

3:20–3:35

Understanding How the Brain Detects Threats

Brian Leventhal
Clarkson University

The focus of this work is developing an artificial neural network model simulating how the brain detects threats. Previously, a model was developed containing seventeen connections between different attention, sensory, response, and threat detector nodes for somatosensory and visual tasks. The optimization used to fit these 17 parameters resulted in connections that were not physiologically tenable. This effort is to improve the model and optimal solution by considering physical constraints within the brain architecture. After calibrating the model, an analysis of variance approach will be used to determine the sensitivities of the model parameters.

3:40–3:55

Modeling the Spread of *Porphyric Hemophilia*

Benjamin Ritz
Clarkson University

Porphyric Hemophilia is a blood-borne disease with devastating repercussions. The infected become gaunt and pale, acquire several severe allergies, and, perhaps worst of all, lust to feed on human blood. Better known as vampires, these infected spread the disease as they feed. In response to a growing popularity of vampires in recent years, we have constructed several mathematical models which represent the spread of vampirism through a human population. These models draw heavily on both pop culture and the occult folklore regarding vampires, and may shed some light on these creatures of the night.

PME Session #1

Room: Phipps **2:00P.M. – 3:55P.M.**

2:00–2:15

Complex Multiplication on Elliptic Curves

Drew Tillis
Hendrix College

My project explores elliptic curves and the structure of their rational points. The points of such curves form a group under an additive operation. Some curves have complex multiplication, a mapping of points on the curve. I have examined examples of curves in finite groups with and without complex multiplication.

2:20–2:35

An Investigation of the Isoperimetric Inequality

Moriah Wright
Youngstown State University

The classical isoperimetric problem dates back to ancient times. The problem can be simply stated as follows: Of all closed curves in the plane of fixed perimeter, which one encloses the maximal area? The solution to the isoperimetric problem is usually given in the form of the isoperimetric inequality. We will give a proof of the isoperimetric inequality as given by Erhard Schmidt which uses the arc length formula, Greens Theorem, and the Cauchy-Schwartz Inequality.

2:40–2:55

Balanced Sequences and Egyptian Fractions

Haoqi Chen
St. Norbert College

A balanced sequence satisfies that the sum and the product of the first k terms are equal. We will discuss constructing balanced sequences, connections to Egyptian fractions and square tilings of the unit square. We will also discuss related representations using graph theory, matrices and electric circuits.

3:00–3:15

Quadratic solutions to $x^4 + y^4 = D^2 z^4$

Melissa Emory
University of Nebraska at Omaha

The Austrian mathematician Alexander Aigner proved in 1934 that there are no nontrivial quadratic solutions to the Fermat equation, $x^4 + y^4 = z^4$, except in $\mathbb{Q}(\sqrt{-7})$. This result was reproved in 1960 by the Russian mathematician D. K. Faddeev. The argument was simplified in 1969 by the British/American mathematician L. J. Mordell. This talk discusses work to extend Aigner's result to beyond the case $D = 1$.

3:20–3:35

How Many Primes are Less than n?

Bradley Slabe

Youngstown State University

There are infinitely many prime numbers, as shown by Euclid more than two millennia ago. Although there is no function that tells exactly how many primes are less than a given positive integer n, there are asymptotic formulas for approximating this number. In this I talk will derive such a formula using only calculus. The result will not only tell us the expected number of primes less than a positive integer n, but also give the probability that n is prime.

3:40–3:55

Understanding Hailstone Sequences Using a New Coding Process

Richard Freedman

Wake Forest University

Hailstone Sequences are orbits formed by the discrete dynamical system mentioned in the Collatz Conjecture ($3x+1$ Problem). Using a new coding process we call set positions, one may determine some behaviors of any Hailstone Sequence. Through a discovery approach, we will explain the derivation of *set* positions and their properties.

PME Session #2

Room: Oliver **2:00P.M. – 3:55P.M.**

2:00–2:15

Handling Constraints with Derivative-Free Optimization

Xiaojing Fu
Clarkson University

There is little guidance for Derivative Free Optimization (DFO) methods to solve problems with linear and non-linear constraints. In this study, we seek to identify the best-performing pair of DFO and constrained methods based on numerical experiments using a suite of constrained optimization test problem.

2:20–2:35

Performance Metrics for Online Ring Routing Algorithms

Neal Barcelo
Denison University

For the problem of routing online flows on a bi-directional ring network, Havill and Hutson (2010) showed that a simple oblivious algorithm which splits the flow inversely proportionally to the length of the flow's shortest path is optimal under the competitive ratio. In this talk we discuss alternative non-oblivious algorithms and examine whether they are superior under various alternatives to the competitive ratio.

2:40–2:55

Experimental Analysis of Online Ring Routing Algorithms

Bryce Pioske
Denison University

It was proved by Havill and Hutson (2010) that a simple oblivious online algorithm has optimal competitive ratio for the problem of routing online splittable flows on a bi-directional ring network. By simulating alternative non-oblivious algorithms, we analyze whether these algorithms perform better than the oblivious algorithm under various probabilistic input distributions. This talk is intended for a general audience.

3:00–3:15

A Graph Theoretical Exploration of the Circular Logic Inherent in Dictionaries

Alexander Golec
Fordham University

In a dictionary, any word is defined in terms of other words. Since most dictionaries do not have an axiomatic set of words which define the rest, they are logically inconsistent. This project finds the directed graph representing logical relationships between words in the 1913 Websters Unabridged Dictionary and investigates the structures found there.

3:20–3:35

Finding the Best Curve to Fit the Data

Xinru Cai
Mount Union College

This talk presents regression analysis for finding the best fit of data for different models. Data from biology and economics are used to find the best fitting straight line, exponential, and power curves. Both multivariable differentiation and logarithmic transformations will be used. Differences will be evaluated by the feasibility of the computing process and Mathematica.

3:40–3:55

Discrete Consideration of Aleksandrov's Projection Theorem

Matt Alexander
Youngstown State University

We will consider problems surrounding a discrete version of Aleksandrov's Projection Theorem. Previous research has provided counterexamples in $\mathbb{Z}^2$ which will be discussed. New research conducted during Kent State's 2010 REU will be presented along with relevant background information.

MAA Session #9

Room: Conference B **4:00P.M. – 6:15P.M.**

4:00–4:15

Control Systems and Linear Algebra: The Electromagnetic Ball Suspension System

Laura Maki
Winona State University

The objective of this research is to look at how linear algebra can be used to model control systems. The magnetic-ball-suspension system uses many aspects of linear algebra. In particular, state-variable analysis of a linear dynamic system is done. Using this analysis, one can predict the future behavior of a system based on initial states. The system analysis will include the use of a system of equations including state equations that are similar to difference equations, a characteristic equation, eigenvalues, and Laplace transforms. In this presentation, I will discuss some background about control systems, information about the electromagnetic ball suspension system, the linear algebra used to analyze the system, and finally, the importance of the results of the analysis.

4:20–4:35

Pseudospectra of Matrices

Stephen Webster
Williams College

We give several equivalent definitions for the pseudospectra of a square matrix. We investigate numerically a few non-normal matrices.

4:40–4:55

March Madness and Markov Chains

Jonathan Inselman
Winona State University

The purpose of this research is to create a model that will provide a more accurate way to predict the outcome of the college basketball tournament called March Madness. This model will include different factors that are used to determine a given team's talent and skill. A weighted equation will combine the factors, field goal percentage, winning percentage, and RPI rating, creating a 2×2 stochastic matrix modeling each matchup in the tournament. The steady-state vector can be found from each stochastic matrix, providing the probability that a certain team will win a given game against a certain opponent. In this presentation, I will discuss the how I constructed the model and how it is used to correctly predict the outcome of the tournament games.

5:00–5:15

Intersecting Cylinders at Arbitrary Angles

Yuri Calustro

Longwood University

This research serves as an extension of the calculus problem in which the volume of intersecting perpendicular cylinders is calculated. Given that both cylinders are of equal radius and intersect at an arbitrary angle, α, the volume is determined by expressing one cylinder as a series of shifting ellipses. We then determine the total volume of a chain of n cylinders in which two cylinders intersect at each joint. The figure created will resemble a regular n-sided polygon, represented by a series of pipes connected at various angles.

5:20–5:35

Mathematical Economics: The Leontief Input-Output Model

Brandon Milonovich

The College of Saint Rose

One of the great applications of linear algebra in modern history is to create economic models that can be used to forecast the activity within a certain economy. Wassily Leontief is famous for being the first to develop the Input-Output Economic Model which divides the economy into sectors such as the coal industry, the automotive industry, communications and so on, and examines the individual input and output of each sector to the economy. Leontief's system starts with an Input-Output table where each row of the table represents the output sold by each sector while each column represents the purchases made by the sector. From Leontief's original work, Leontief created a system of 500 equations with 500 unknowns. At the time, this analysis was much too large for any computer to solve; therefore, he had to narrow his system down to a 42×42 system. Modern advancements in computers have allowed for much larger systems to be calculated and are still used to analyze economic data. Today, Leontief's ideas of using systems of linear equations to model real world examples is used in many fields varying from oil exploration, linear programming, electrical networks, and many more. The Leontief input-output model is still used to model economies throughout the world, as well as the global economy itself. Here, we further explore Leontief's work on economic models by presenting a case study of the Leontief input-output model with real data on the exchange of goods and services in the U.S. for 1992.

5:40–5:55

The enumeration of magic circles and more

Taylor Asbury

Sam Houston State University

Magic circles are mathematical objects with properties similar to those of magic squares. Those magic circles with a given sum have been recently enumerated using techniques from algebraic geometry. The three-dimensional version of a magic circle – a magic cylinder or torus – will be defined, and a description of the techniques used to enumerate these objects will be presented.

6:00–6:15

The Search for the Odd Perfect Number

Jakob Weisblat
John Carroll University

A perfect number is a number whose proper divisors add up to the number itself. All known perfect numbers are of the form $(2^p - 1)(2^{p-1})$ where p is prime and $2^p - 1$ is prime. This talk will consider the possibility of an odd perfect number. After considering criteria for the prime factorization of an odd perfect number, many categories of odds will be eliminated. The remaining categories will then be more thoroughly considered. The first part of the talk will be my personal research and investigations without having looked at anyone's previous work. Next, interesting previous studies on this matter will be discussed. Finally, my personal work will be compared to the previous analyses, and my research will be extended using this new information.

MAA Session #10

Room: Conference C **4:00P.M. – 6:15P.M.**

4:00–4:15

Graph Theoretic Approach to Texas Hold'em

David Whitaker, Hannah Blalock, and Deborah Furr
North Georgia College and State University

The goal of this research project was to analyze odds in Texas Hold'em Poker using a graph theoretic approach. The deck can be represented as a lattice with order 52 where the two vertices representing the player's two cards are fixed. The set of possible flops is the same as the set of three-cycles in the remaining 50 vertices. By separating the cards into categories according to the kinds of hands that they can contribute to, the three-cycles can be characterized so that the possible hands can be counted within each class. In order to count the Straights and Straight-Draws, it was necessary to make a separate directed graph with edge weighting. Edges were weighted according to how many rows in the lattice were skipped between one vertex and another. Also, since there is an overlap between the flush cards and straight cards, the flush cards can be weighted in a way to distinguish themselves. While we focused specifically on suited-connectors and only counted hands which were formed on the flop, the same methodology could be applied to counting possible hands for any two cards a player might be holding. Furthermore the turn and the river can be counted by looking at them as pendant edges to the three-cycle. Eventually this method could be used to determine the strength of any hand that a player might be dealt.

4:20–4:35

Tournaments

Sam Anderson
Augustana College

Tournaments are directed graphs for which any two different vertices are connected by exactly one edge. We will define terms such as 'transitive' and '3-cycle' and provide examples as illustrations. We will prove that every tournament is either transitive or contains a 3-cycle, but that no tournament is both transitive and contains a 3-cycle.

4:40–4:55

The Search for Extremal Graphs

Richard Ligo
Westminster College

Let G be a graph with v vertices. What is the maximum number of edges G may contain, while still containing no 3-cycle or 4-cycle as a subgraph? We have used computers to algorithmically search for the answer to this question, and in some cases have found graphs which improve the known lower bounds. We will give an introduction to the problem, describe what is known, including our preliminary results, and touch on some directions for future work.

5:00–5:15

A Preview of Self-Intersecting Polygons

Nicholas Owad
Kutztown University

This talk will cover the essential aspects of Twisting Theory, a mechanism that was developed by the author to generate self-intersecting polygons through sequences of "twists". After exploring the basic definitions and operations of the theory, stars and bowties will be presented in depth as examples of the connections between twists and self-intersections. We will state and prove some major theorems, and conclude with open questions and conjectures.

5:20–5:35

Exploring Paths and Where They Take Us

Bryan McCauley
Winona State University

Topological graphs can be represented as many different objects and relationships. They can represent roads, networks, and circuits. However these graphs that represent these relationships and objects often can get very large and complicated. So, a large part of graph theory consists of dealing with matrices that define these graphs we work with. The graphs can be used to find relationships between people, places, and things, including round robin tournaments and flight patterns. This presentation will deal with using these matrices, graph theory, and linear algebra to determine how many paths of length n exist and where they are located in the graph. Then this can be used to work with relationships and situations that are encountered in everyday life.

5:40–5:55

Pursuit and Avoidance on Graphs

Raymond Perkins, Joshua Ritter, and Garrett Rodriguez
Morehouse College, Michigan State University, and Alma College

We study the game of cops and robbers on a finite graph. In its most basic form it involves two players, one cop and one robber, and the objective for the cop player is to capture the robber and the robber's goal is to avoid capture indefinitely. The players start on different vertices, with the cop choosing first and robber second and they take turns respectively moving on undirected edges. We survey some known results about how many cops it takes to catch a robber on a finite graph, and present the results of our summer research project at Michigan State University during Summer 2010.

6:00–6:15

Graphs with Cut-Resistant 2-Colorings

Matthew Griisser and Andrew Pfeiffer
North Georgia College and State University

In this talk, we will explore conditions under which a graph has a cut-resistant 2-coloring. Such a graph is one in which there exists a vertex 2-coloring, not necessarily proper, such that when the edges of any cycle in the graph are removed, each component of the resulting graph has at least 1 vertex of each color. We will provide examples of such graphs and establish a set of characteristics that are sufficient for the graph to have a cut-resistant 2-coloring.

MAA Session #11

Room: Carnegie III **4:00P.M. – 6:15P.M.**

4:00–4:15

In Silico Study of Rhythmic Activity Underlying Breathing Using NEURON and Python

Youngmin Park

Case Western Reserve University

The cells in the mammalian brain responsible for breathing are located in the pre-Bötzinger complex (pBC), a rhythm generating region of the brain stem containing approximately 800 neurons. The generation of robust breathing rhythms is of fundamental biological interest, as well as having possible clinical importance for breathing disorders such as apnea of prematurity in preterm infants. In order to advance our understanding of the dynamics of rhythmic activity in the pBC, we are using two computer languages to study mathematical models of pBC cell activity: NEURON and Python. NEURON is used as a Python module to effectively utilize the suite of analysis tools available in Python. Using these two languages, one simulated pBC cell has been created using data from multiple papers including Butera et al. 1999a, Purvis et al. 2007, Bazenhov et al. 2004, Purvis & Butera 2005, and Koizumi et al. 2008. A working computer simulation of a single pBC nerve cell is an important step in creating a 200-300 cell model which will be used to study the factors affecting robust synchronization of the pBC network.

4:20–4:35

The Mathematical Process of Computer Assisted Tomography

Samantha Erwin

Murray State University

Computer Assisted Tomography is frequently used in modern medicine through the CT scan, but the mathematical concepts behind it are a mystery to most users. This presentation will be an analysis of the mathematical equations that made Computer Assisted Tomography possible. The general equations and broad explanations will be presented. The scope to which Computer Assisted Tomography has impacted biology will be discussed as well as the impact that these mathematical concepts have on modern medicine.

4:40–4:55

A Mathematical Approach to the Dynamics and Treatment of HIV

Paul Read

Purdue University Calumet

In treating HIV infection, strict adherence to drug therapy is crucial in maintaining a low viral load, but the high dosages required for this often have toxic side effects which make perfect adherence to Antiretroviral Therapy (ART) unsustainable. In this talk we introduce a mathematical model to investigate theoretically and numerically the effect of immune effectors in modeling HIV pathogenesis during ART, showing a higher rebound for healthy T-cell concentration than drug therapy alone. Nevertheless, even in the presence of drug therapy, ongoing viral replication can lead to the emergence of drug-resistant virus variances. We address this fact by including in our mathematical model two viral strains, wild-type and drug-resistant. A pharmacokinetic model is employed to estimate the drug efficacies for both strains of virus. We investigate numerically how time-varying drug efficacy affects the antiviral response and we characterize successful drugs or drug combination scenarios for both strains of virus. maintaining a low viral load, but the high dosages required for this often have toxic side effects which make perfect adherence to Antiretroviral Therapy (ART) unsustainable. In this talk we assess the effect of treatment consisting of a combination of several antiretroviral drugs. Nevertheless, even in the presence of drug therapy, ongoing viral replication can lead to the emergence of drug-resistant virus variances. Thus, by including two viral strains, wild-type and drug-resistant, we characterize successful drugs or drug combination scenarios for both strains of virus.

5:00–5:15

A Clarification of the Idiom "No Pain, No Gain"

Andrew Hosie

Edinboro University or Pennsylvania

This talk stems from research into using differential equations to model a human's growth. The question posed asks if pain is in fact necessary for growth. Several models are developed to clarify the question, and these models in turn undergo a compare and contrast critique.

5:20–5:35

Biological Applications of Limit Cycles

David Zitelli

United States Air Force Academy

Limit cycles are examined and applied to the biological field of neuropsychology–specifically they are used to model the firing of neurons in the human body. This examination includes a discussion of the Hodgkin-Huxley equations, which can be simplified to the Fitzhugh-Nagumo model. The Poincare-Bendixson theorem is discussed and used to demonstrate an example of the Fitzhugh-Nagumo model.

5:40–5:55

Computational Analysis of MR Spectroscopy Signals to Detect Metabolic Disorders

Gregory Schwartz
Franklin and Marshall College

The concentration of certain metabolites within a bodily organ has been shown to be directly correlated to many types of diseases and tumors and thus invaluable to the medical field. Analysis of magnetic resonance (MR) spectroscopy is a relatively novel method for quantifying these metabolite concentrations. Due to the level of noise, water, overlapping peaks, and unwanted metabolites in the spectra, this technique has led to low levels of reliability, with only a few programs having some success in confidence levels. This project uses the freely available software package AQSES to optimize the accuracy of this technique, and to mold it for clinical use. We demonstrate the technique on data collected in collaboration with the Clinic for Special Children, specializing in inherited metabolic disorders among the Amish and Mennonite communities.

6:00–6:15

Effects of Motility and Contact Inhibition on Tumor Viability

Jonathan Li
UC Irvine and St. Margaret's Episcopal School

The effect of cell migration on tumor growth was analyzed using the Cellular Potts Model. Motility, cell-to-cell adhesion, contact inhibition, and cell compressibility are incorporated into the model. We find that increased motility has a direct effect on the growth rate of a tumor. Cell lines with greater motility overcome the attractive forces of cell-to-cell adhesion and have more space to proliferate. In addition, contact inhibition amplifies the effect of motility. Strict contact inhibition penalizes clumped cells by halting their growth, giving motile cells a greater advantage. These results confirm that migration correlates with tumor viability. The model also shows that cells with less response to contact inhibition are more invasive. This raises questions on the effectiveness of some chemotherapy treatments, which may actually select for these more invasive cells.

PME Session #3

Room: Phipps **4:00P.M. – 6:15P.M.**

4:00–4:15

Tiling Partitions with Squares and Dominoes

Danielle Chomic and Alexander White

Pepperdine University

We will discuss tilings of partition shapes with squares and dominoes. We will first give a recursive formula for $D_{n,m}$, the tilings of a partition with two parts, n and m. We will discuss results for partitions containing a 2×2 Durfee square and conjectures for partitions with $n\times n$ Durfee squares.

4:20–4:35

Image Processing Techniques Using Sparse and Redundant Dictionaries

Josh Koslosky

Duquesne University

Recent research in image processing has shown that sparse and redundant representations of image patches can be used to perform various techniques such as denoising and deblurring of images. These representations can be formed using dictionaries that are either fixed using the Discrete Cosine Transform and Pre-constructed Image Databases or they can be learned from the noisy data. Elad and Aaron proposed the K-svd model (a modification of the Singular Value Decomposition inspired by K-means) for learning the dictionary from the data. Finding the best patch representation leads to a constrained optimization problem which, depending on its formulation, can be nonconvex. In this talk we analyze their algorithm and propose modifications in order to tailor the dictionaries for denoising and deblurring in an effort to achieve better image representation.

4:40–4:55

Factoring a Semiprime n by Estimating $\phi(n)$

Kyle Kloster

Fordham University

An algorithm is presented that factors a semiprime, $n = pq$, by estimating $\phi(n)$. The algorithm uses precisely $(\sqrt{p} - \sqrt{q})^2/\lfloor \log_2(n) \rfloor$ iterations. It is faster than the Quadratic Sieve when $|p - q|$ is small and always faster than Fermat Factorization. Furthermore, it is shown that the algorithm can quickly factor some semiprimes constructed according to current RSA standards.

5:00–5:15

Approximating Derivatives Using Taylor Series and Vandermonde Matrices

Darlena Kern

Pepperdine University

A basic numerical analysis problem is that given any n distinct values of function f, we can approximate the k^{th} derivative $f^{(k)}(a)$ for $k = 0, \ldots, n-1$ for any a. We consider this problem and find the resulting formulae in the general case. Our work depends heavily on Taylor Series and Vandermonde Matrices.

5:20–5:35

A Game Theory Approach to Cascading Behavior in Networks

James Manning

University of South Carolina

This project will study the rapid flow of information in large social networks. A graph is built with nodes representing individuals in a population and an edge between two nodes if they have some form of communication. We seek variations on the model to better determine the most influential players.

5:40–5:55

Existence and Uniqueness of Solutions to a One-Dimensional Model of Plasma Dynamics

Charles Nguyen

University of Texas at Arlington

In this talk, we will describe a one-dimensional system of partial differential equations which model magnetic waves in a plasma. Specifically, we will show how a smooth solution to such equations can be constructed by proving the uniform convergence of a sequence of approximating functions. In addition, we will discuss the uniqueness of these solutions.

6:00–6:15

Combinatorical Applications of Gray Codes

Bryan Hong

William Paterson University

I will show the reason for the creation of Gray Codes (modified binary code)and explain how it is made/used. Then I will apply it to finding the permutations of n-digit transpositions. Finally, I will show how $n + 1$ distinct permutations can generate n non-distinct permutations.

PME Session #4

Room: Oliver **4:00P.M. – 6:15P.M.**

4:00–4:15

Screensize of Paths

Anthony Harrison
Texas State University

Sphere of influence graphs (SIGs) are a representation of spatial relationships. We explore a graph invariant for SIGs, the screen size, the smallest integer k such that a SIG can be realized on an $k \times k$ grid. We find this for paths and discuss integer programming formulations for it.

4:20–4:35

Math and Music - Intricate Relations

Teresa Schermerhorn
Ashland University

This presentation will explore some musical concepts using the mathematical definitions of symmetry, transformations, groups, subsets, and other linear algebra topics. Interesting (and mind-blowing) compositions will be unveiled through mathematical eyes, the works of composers will be brought to a simple mathematical science, and difficult mathematical ideas will be illustrated using visual and auditory examples.

4:40–4:55

Higher Dimensions and Error Correcting Codes

Kristin Reinsvold
College of St. Benedict and St. Johns University

Error correcting codes consist of code words different enough that a mistake in transmission can be fixed. These code words are vectors in n-dimensional space with sufficient distances between them. We use various methods to find bounds for the possible number of binary code words in different dimensions.

5:00–5:15

Mapping the Liberal Arts: The Graph Theory Behind Your Degree

Lindsay Van Leir
Roanoke College

Liberal arts can be tricky. Students: Want to be sure you'll graduate on time? Professors: Need to format a new curriculum in the liberal arts? Administrators: Want to analyze your current program? Find out how graph theory can help dissect some of these typical curriculum problems!

5:20–5:35

A Movement Algorithm for a Zero Turn Machine

Corey Vorland
St. Norbert College

Is it possible to develop a zero-turn-lawnmower simulator? We will present the concept of zero turn movement from a mathematical perspective. Using only basic trigonometry, we will show how the simulator can calculate the new coordinates of a zero turn machine using user input.

5:40–5:55

Math is Mean

Allison Spencer
SUNY Fredonia

An ellipse can be defined as the locus of points in a plane with a fixed average distance from two fixed points (the foci for the ellipse). Here, the "average" used is the "arithmetic mean," which is the usual mean people use to average two numbers x and $y : (x + y)/2$. We explore what happens when different means are used. For example, the geometric mean of x and y is the square root of x times y. We also explore what happens when there are more than two foci.

6:00–6:15

Optimal Bluffing Strategies in Poker

Mitch Staehle
Western Oregon University

Do you know when to hold'em and when to fold'em? Enjoy math that has true applications which you can use in casinos? Then this is the talk for you! I am going to be exploring a very basic and common situation in poker in which everyone can understand.

MAA Session #12

Room: Conference B **8:30A.M. – 10:25A.M.**

8:30–8:45

Improving Abundancy Bounds

Elizabeth McCaslin and Fenghao Wang
McDaniel College

We will examine the percentage of integers n such that $\frac{\sigma(n)}{n}$ is at least x, where $\sigma(n)$ is the sum of all positive divisors of n. It is known that the bounds for the solutions to $\frac{\sigma(n)}{n} \geq 2$ are 0.2474 and 0.2480; however, the previous best known bounds for some x are much wider. We explore methods for improving these bounds.

8:50–9:05

Congruences for Partition Function

Liem Nguyen
University of Wisconsin, Oshkosh

A k-regular partition of a positive integer n is a partition of n whose parts are not divisible by k. In this talk we will discuss techniques used to study these partitions and give exact criteria for when the 13-regular partition function is even. We also show that this function satisfies Ramanujan-type congruences modulo 2.

9:10–9:25

Counting Modular Tableaux

Bjorn Wastvedt
St. Olaf College

In this paper we provide a bijection between all modular tableaux of size kn and all partitions of n into k colors. By using the generating function for the number of k-colored partitions of n, we can count the number of modular tableaux of size kn. We also provide an alternate proof of Stanton and White's bijection between k-rim hook tableaux of size kn and k-tuples of standard tableaux.

9:30–9:45

Variation of Pascal's Triangle

Anjali Taneja
Boston University

Pascal's triangle has been a well-known mathematical figure for centuries because of its intriguing mathematical properties. One remarkable quality is that the sum of every line is a power of 2. We defined a variant of Pascal's triangle, also a triangle, for which the sum of numbers in every line gives the power of any given number. Using this method, powers of very complicated numbers could be found through constructing the triangle and using a recursive formula to obtain the power in closed form.

9:50–10:05

Examining General Fibonacci Sequences Modulo a Prime

Joshua Ide
Shippensburg University

The Fibonacci sequence is one of the most recognized recursive sequences in all of mathematics. General Fibonacci sequences are of the same form, but they begin with any two arbitrary integer starting values. When using modular arithmetic on both the Fibonacci sequence and general Fibonacci sequences, interesting properties are exposed including the fact that all sequences under modular arithmetic are periodic. In this presentation, we will discuss the possible values for the period of general Fibonacci sequences modulo m, how these sequences are created, and how many unique sequences are associated with a given modulus. Additionally, we will discuss the construction of orbits by scalar multiplication of arbitrary sequences using residues of the modulus and the subsequent orbit structure of various moduli.

10:10–10:25

Benford's Law For Coefficients of Modular Forms and Partition Functions

Larry Rolen
UW Madison

It has long been observed that many naturally occurring statistics and arithmetic functions have surprising properties. For example, if we examine the first digits of a sequence in base 10, instead of the a priori estimate that each digit should appear equally often we find that the first digit is a 1 about 6 times as often as it is a 9. Although this is a well-known heuristic, it has only been proven for a relatively small class of arithmetic functions. Using recent results of Ken Ono and Kathrin Bringmann on coefficients of harmonic Maass forms as well as classical theory of uniform distribution, we prove that the coefficients of an infinite class of modular forms satisfy the Benford distribution. This allows us to generate large classes of sequences which were previously unknown to be Benford. In particular, we will show this for the partition function $p(n)$ as well as numerous classes of natural partition functions.

10:30–10:45

Constructing Arbitrarily Long Sequences of Primes

Elijah Allen
Armstrong Atlantic State University

In 2006, Terrance Tao won the fields medal for his paper proving that there exist arithmetic progressions that contain arbitrarily long sequences of primes. Tao's paper showed that for any integer k that there exists an arithmetic sequence of all primes of that length but it did not show how one might be able to find such a sequence. While giving some information on the density, this paper also does not say if all such sequences are unique (such as 3, 5 and 7 for $k = 3$), happen only a finite number of times, or happen infinitely often. It remains unresolved as to if other arbitrarily long sequences such as of sequences Sophie Germain primes that Cunningham described could be of arbitrary length as well. For this talk we shall explore methods of constructing these sorts of sequences of primes and give some insights on cardinality of such sets.

MAA Session #13

Room: Conference C **8:30A.M. – 10:25A.M.**

8:30–8:45

Cluster Analysis

Zhaoqun Niu
Seattle Central Community College

Locating multiple outliers in multivariate data sets is a challenge. This project explores an innovative strategy to locate potential outliers using cluster analysis. These potential outliers are later examined to determine if they are influential (or leverage) points. Cluster analysis is a important exploratory statistical tool used in many fields, including biology, medicine, market research, social networks etc. Cluster analysis is the assignment of observations, information, or records into similar groups or sets. This new method of influential points detection groups individual points into clusters so that the relationship between their locations and distances from one another is highlighted. This project focused on the nearest neighborhood method of cluster analysis coupled with OLS regression. The advantage of this method largely lies with the simplicity of the logic underlying the technique. This simplicity enables the method to gain greater adoptability with fewer assumptions, and hence, can be deployed in many different data "environments" without advance knowledge of the data set. Using two or three variables and graphing software we can plot points and visualize the data to locate possible outliers, but when we deal with four or more variables this task is nearly impossible. In this case clustering, such as a 5-dimension data set. may be the only way to analyze the data. While this method of outlier detection has some obvious advantages, the method has never been analyzed in relation to regression analysis and simultaneous location of more than one influential point in the data set. The goal of this project is to examine the method within both real world and simulated data, to verify the method and find the limits of the technique. Results obtained using this method on previously analyzed data sets containing outliers and time series data will be presented. Possible anomalies with the method will briefly be discussed.

8:50–9:05

Arkansas Collegiate Performance Research

Morgan Fincher
Arkansas State University

"Arkansas Collegiate Performance Research" will investigate the meaning of "performance" as it applies to higher education. Both existing resources and surveying of students will be used to score the performance of 4-year institutions of higher education in the state of Arkansas. Using factor analysis will minimize the number of variables used to define performance. Participants of the study will be selected by cluster sampling, and the results from their surveys will be added to factual results collected from the school's database. The final data from each University/College will be compared to all others. The schools will be placed in to groups similar in performance, using cluster analysis. Lastly, MANOVA (multivariate analysis of variance) will be used to test if the performances are significantly different. If so, multiple comparison will be used to rank them.

9:10–9:25

Predicting Top 6 Most Influential Languages

Ka Hei Kathleen Wong
Winona State University

The objective of this research is to predict the top 6 most influential languages in the near future. As the world shifts to a global society, learning different languages has been a trend and an important factor to success. With mathematics, the most helpful language in the near future can be predicted with Markov Chains Matrix. In this presentation, the advantages of knowing a second language and the usage of the result will be covered. Also, the method of predicting the next most influential languages will be presented and result will be analyzed with graphs. At the end, trends relating to gender affecting future statistics would be discussed.

9:30–9:45

Understanding Biodiversity Through Distance Measures and Multidimensional Plots

Samrachana Adhikari
Mount Holyoke College

A major problem in ecology is to understand how the diversity of living things changes from one location to another. In this talk we will focus on the statistical methods used to analyze ecological data and their significance in understanding biodiversity. In particular, we will see how distance measures and multidimensional plots work using the database of insect observation from the Great Smoky Mountains National Park and try to predict the biodiversity of the park.

9:50–10:05

On the Recurrence of Modified Simple Random Walks in $\mathbb{Z}^d$

Charles Morrissey
Michigan State University

It is known that the nearest neighbor simple random walk is recurrent in $\mathbb{Z}^d$ for $d \leq 2, d \in \mathbb{N}$ and transient for $d \geq 3$. We introduce a modified simple random walk where walker first moves left or right, and then moves up or down in one turn. For this process we investigate whether the recurrence/transient properties are preserved. Further we study whether the distribution of the location of the walker follows a Gaussian distribution.

10:10–10:25

Phase Transitions in Biased and Long-Jump Random Walks

Ryan Spitler
Alma College

It is known that the nearest neighbor random walk defined in $\mathbb{Z}^d$ (d-dimensional integer lattice) is recurrent for $d = 1, 2$ and transient for $d \geq 3$. In this talk we introduce long-jump random walks where at each time the random walker can jump to sites other than its nearest neighbors, according to some probability distribution. We will show that some long-jump random walks exhibit transient behavior for $d \geq 1$. Analytic as well as simulation results will be presented.

MAA Session #14

Room: Carnegie III **8:30A.M. – 10:25A.M.**

8:30–8:45

Interpretations of Some Theorems of Projective Geometry in Euclidean Space

Ashley Nelson
Emory & Henry College

Among the highlights of projective geometry are the theorems of Desargues and Pappus. Each of these have fascinating connections to the world of Euclidean geometry. Through our study, unique corollaries of these theorems were found in a Euclidean setting. Some were proved using Euclidean techniques. Additionally, interesting facts in both projective and Euclidean settings were found. Diagrams were built and will be demonstrated to depict the results.

8:50–9:05

Planar Partitions Minimizing Perimeter and Number of Vertices

Isamar Rosa
University of Puerto Rico, Mayaguez

In 1999 Hales proved that regular hexagons provide the least-perimeter way to partition the plane into equal areas. We consider the problem with an added penalty for vertices.

9:10–9:25

Spacial Partitions Minimizing Interfacial Area, Edge-length, and Number of Vertices

Yifei Li
Berea College

In 1999 Weaire and Phelan found a new better way to partition space into unit volumes and minimize interface area. We consider the problem with an added penalty for edges and vertices.

9:30–9:45

The Geometry of Parallel Parking

Daniel Huston
Mount Union College

Why is it so hard to parallel park? Many people find parallel parking very difficult. There are many factors that affect a person's ability to successfully parallel park. In this presentation, I will focus on the physical characteristics of the car and how the geometry of the vehicle affects parallel parking. This geometry includes such characteristics as the dimensions of the car, the turning radius, wheelbase, etc. Through the use of a related article and my own expanded formula, I will compare different vehicles and determine the optimal vehicle and space needed to successfully parallel park.

9:50–10:05

Polygons Minimizing Perimeter and Number of Vertices

Elena Wikner
Williams College

Given nonnegative constants a, b, we seek a polygon of prescribed area minimizing a times the number of vertices plus b times the total perimeter.

10:10–10:25

A Generalization of the Law of Cosines

Lee Collins
Rowan University

The familiar Law of Cosines for a triangle with sides a, b, and c states that c^2 equals an expression involving two terms. The first term is the sum of remaining sides a and b: $a^2 + b^2$. The second term is $-2ab\cos\widehat{ab}$, where $\widehat{ab}$ is the angle made by the sides of lengths a and b. We show that this formula generalizes nicely for an arbitrary quadrilateral of sides a, b, c and d. Again, the formula for the square of side d involves two terms. The first term is $a^2 + b^2 + c^2$, while the second term is $-2ab\cos\widehat{ab} - 2ac\cos\widehat{ac} - 2bc\cos\widehat{bc}$. This is clearly a generalization of the familiar law of cosines for a triangle. Furthermore, we show this generalization holds for any n-gon and how it extends to polyhedra.

MAA Session #22

Room: Three Rivers **8:30A.M. – 11:55A.M.**

Abstracts received too late to appear in print.
Please refer to the MAA Student web page at:
`http://www.maa.org/mathfest/students.cfm`
for presenters' names, talk titles, and abstracts.

PME Session #5

Room: Phipps **8:30A.M. – 11:45A.M.**

8:30–8:45

Modeling Gastric Emptying

Kelley Moran
Goucher College

My research will focus on the digestive system and the gastric emptying of ingested foodstuffs. To numerically simulate a compartmental model that describes relationships between the digestive organs, I will analyze several factors of digestion: absorption in the stomach, gastric motility, and how macronutrients affect the digestive process.

8:50–9:05

The Mathematics of Superconductivity

Yan Zhuang
Goucher College

This presentation will give a thorough overview of the background and outcomes of theoretical physics research in superconductivity, a subfield of condensed matter physics that combines elements of electromagnetism, quantum mechanics, and thermodynamics. Specifically, we are investigating the thermal conductivity of MgB_2 superconductors and newly discovered iron-based superconductors placed in high magnetic fields. The extensive role of mathematics and the computational tools used in this research will be emphasized.

9:10–9:25

Modeling the *Manduca sexta* Midgut

Jennifer Garbett
Kenyon College

Manduca sexta is an ideal model organism in the study of metabolism, and the relationship between the surface area of the caterpillar's midgut and its metabolic rate may help us understand metabolic scaling. I will present a method for calculating midgut surface area and then discuss how it relates to metabolism.

9:30–9:45

Mathematical Modeling of Riparian Ecosystems and Land-form Dynamics

Lisa Curll
Youngstown State University

Zoar Valley, in New York State, has been isolated from logging and other human disturbance even though early colonization, and contains one of the last Old-Growth forests in the northeastern United States. The valley is subject to diverse river conditions which create and erode portions of the valley floor and change the characteristics of the riparian ecosystems. We developed a system of differential equations which models forest succession, irregular and random flood events, and steady-states.

9:50–10:05

Modeling of Regulation of Gene Expressions in the Presence of Toxic Selenite in *E. coli*

Sepideh Khavari
Youngstown State University

The regulation of gene expressions for a wild-type Selenite-resistant strain and several mutants of *E. coli* is investigated. A system of differential equations is used to model the expression of certain genes in the presence of toxic Selenite. This system of differential equations can help identify the phase of growth when specific genes are expressed in the presence of Selenite.

10:10–10:25

Modeling Response to β-Adrenergic Stimulation in Rabbit Cardiac Myocytes

Josh Mike
Youngstown State University

Sex and regional (Apex vs Base) differences in L-type calcium current have been shown to contribute to sex differences in cardiac arrhythmia sensitivity. In Long QT syndrome (LQTS), where the recovery time of a heartbeat (QT-interval) is lengthened, adult females are more susceptible to arrhythmia than adult males, and the trend is reverse in youth rabbits. The investigation of our Model of a cardiac myocyte seeks to determine the cause for differences in arrhythmia sensitivity due to LQTS alone and LQTS type-2 in tandem with β-adrenergic stimulation (the “fight or flight” response).

10:30–10:45

The Four Vertex Theorem

Tyler Hardgrove
Youngstown State University

The four-vertex theorem states that the curvature function of a simple, closed plane curve has at least four local extrema (specifically, at least two local maxima and at least two local minima). The name of the theorem derives from the convention of calling an extreme point of the curvature function a vertex. This talk will present a simplified version of this topic.

10:50–11:05

Lies in Group Theory: Finding Minimal Counterexamples to False Conjectures

David Daniels
Western Oregon University

Disproving a false conjecture requires no elaborate proof, a mere counterexample is sufficient. Beginning with a list of known false conjectures in Group Theory, it is the purpose of this paper to find a smallest counterexample for each.

11:10–11:25

Variations of the Counterfeit Coin Problem

Kayla Pope
St. Norbert College

The counterfeit coin problem is a classic involving a number of coins and a balance scale used to determine a single counterfeit among them. We will discuss variations of the problem including an increase in the number of counterfeits and the case where the number of counterfeits is unknown.

11:30–11:45

On the Distribution of Zeros of Derivatives of Functions of the Form $f(z) = P(z)e^{Q(z)}$

Hannah Stanton
University of Montana

Let $f(z) = P(z)e^{Q(z)}$ where P, Q are real polynomials. It is known that f'' has at least m non-real zeros where m depends on the polynomial Q. We look at how the number of non-real zeros of $f^{(k)}$ increases as k increases.

PME Session #6

Room: Oliver **8:30A.M. – 11:45A.M.**

8:30–8:45

Model of Chitin Synthase Gene Expressions

Randi Yazvac
Youngstown State University

Penicillium marneffei is a human pathogen that has a dimorphic life cycle: at 25° C it grows as a mold and at 37° C it grows as a fission yeast. Chitin is the structural foundation of the fungal cell wall, and the differential expression of chitin synthase genes is thought to play an essential role in this dimorphic switch. We used a simple dynamic model to explore the gene regulation of chitin synthases. A Boolean network is used to examine when various chitin synthase genes are turned on or off.

8:50–9:05

Efficiency of Orbit Transfers

Dylan Asmar
United States Air Force Academy

Satellites often change orbits for various reasons. The primary concern with orbit transfers is fuel efficiency. We will discuss fuel efficiencies of orbital transfers that involve plane changes and analyze common rules of thumb that try and maximize fuel efficiency.

9:10–9:25

An Application of the Tolerance Graph as a Model for the Assembly of Short Read Sequences

Julia Warnke
University of Nebraska at Omaha

Graphs are a powerful tool for modeling a variety of biological problems. We present an application of the tolerance graph as a model for the assembly of reads produced by next-generation sequencing technologies. Results from an assembler that uses the tolerance graph as its primary data structure will be given.

9:30–9:45

Evaluating Statistical Methodology for Gene Set Analyses

Scott Powers
University of North Carolina at Chapel Hill

Statistical genetics analyses seeking to link diseases to parts of the human genome have undergone a paradigm shift in recent years to take into account that certain genes work together in gene sets, sometimes called pathways. By including biological knowledge about the interaction between genes, new statistical tests have demonstrated the capacity to improve the power of statistical inference while controlling the type-I error rate. However, as this is a relatively new line of thinking, there is a lack of consensus in the mathematical statistics community as to what the optimal method is. We compare asymptotic and simulation-based methods that have been proposed, including Fisher's exact test, the Komogorov-Smirnov test and others in an effort to maximize statistical power while maintaining type-I error rates.

9:50–10:05

Regulatory Network Models in Biology

Manasi Vartak

Worcester Polytechnic Institute

In this project, we studied transcriptional regulation in *C. elegans* via techniques like degree distribution analysis, motifs, gene regulation subgraphs etc. Our analysis discovered previously unknown motifs likely to have biological significance. We also introduced a new technique for quantifying gene regulation and formulated a hypothesis predicting autoregulation.

10:10–10:25

The Mathematics of Falling Sand Grains: How is Sand Deposited on the Back of a Dune?

Robert Nash

Hope College

The dynamics of sand dunes have been studied since the 1930's, but it is still unknown how sand is deposited once it has passed the crest of the dune. I will present a model, based on fundamental physical principles, that predicts the this deposition pattern.

10:30–10:45

Teaching Algebra Concepts through Technology

Chelsea Miedema

Hope College

This presentation is based on the research completed by Hope College and 15 surrounding districts (OAISD) that built upon Marzano's Top 9 instructional practice list and Wenglinsky's successful practices. We linked exponential and polynomial function family strategies that support higher level thinking skills to increased Algebra I student achievement. Participants in a three day, overnight summer camp were immersed in hands-on, multi-faceted pedagogy via HeyMath!– an interactive web-based, virtual manipulative from Singapore and through supplemental function family activities (exponential and polynomial). The workshop focused on research-based, practical strategies for all students, including at-risk, ELL, and special education students. The teachers helped struggling students better define, graph, and conceptually understand exponential and polynomial functions as well as increased their own understanding content knowledge of function families. Teachers were given a pre/post assessment of student common misconceptions (CHASM test) and Students were given the student version of the same test. Results will be shared in this presentation.

10:50–11:05

An Introduction to Lie Groups via Matrix Groups

Tara McCart

Youngstown State University

Lie groups are named after the nineteenth century Norwegian mathematician Sophus Lie, who laid the foundations of the theory of continuous transformation groups. Matrix groups are groups of matrices (for example, the general linear group, the special linear group and the orthogonal group), and these give most of the more common examples of Lie groups. In this talk we will illustrate some of the basic notions encountered in Lie groups by doing calculus on matrix groups.

11:10–11:25

An Introduction to Problems in Hyperlinearity and Soficity of One-relator Groups

Nicholas Noblett
Siena College

A one-relator group is a group which is generated by any number of elements but contains only one relator. It is known that all groups which are considered sofic are hyperlinear, but the converse statement is still open. A new class of non-residually solvable hyperlinear one-relator groups will be highlighted.

MAA Session #15

Room: Conference B **2:00P.M. – 3:55P.M.**

2:00–2:15

A Parallel Finite Element Method for the Convection-Diffusion-Reaction Equation

Casey McKnight and Amber O'Connell
Austin Peay State University

The Finite Element Method is a technique for the numerical solution of partial differential equations. The fundamental idea is that a continuous solution to the governing PDE modeling a physical system can be approximated by subdividing the domain into a set of finite geometrical elements, which are triangles for a two-dimensional domain. We then approximate the value of the solution at the nodal points. We discuss some geometrical aspects of the finite element method and present a parallel computing package for solving two-dimensional, second order, linear PDEs. To demonstrate the effectiveness of this parallel computing technique, we solve the convection-diffusion-reaction equation at a very fine precision, and show improvements in both time and accuracy over sequential methods.

2:20–2:35

The Finite Element Method for Elliptic Problems

Zachary Hodge and Jesse Hotchkin
Austin Peay State University

We present the finite element technique for solving elliptic problems. In particular the method of domain decomposition (triangulation) into elements is presented. This reduces the problem into a system of linear equations, whose solution is easier than the original partial differential equation. Examples with error estimates are presented.

2:40–2:55

Instability of BGK Waves in a Model of Plasma Dynamics

Robert Allen
University of Texas at Arlington

In this talk we will investigate the stability properties of solutions to PDEs which model plasma dynamics in one dimension. Upon introducing the model we will discuss the notions of stability and instability and show that it is equivalent to solving an eigenvalue problem. Finally, we will then describe how this eigenvalue problem can be solved.

3:00–3:15

The Helmholtz Equation: Applications to Underwater Acoustics

Jennifer Kile
Marist College

The wave equation can be reduced to the time independent Helmholtz equation by computing the Fourier Transform. This partial differential equation in depth and range can be solved using separation of variables. In depth, this equation yields sinusoidal solutions with discrete spatial frequencies and Hankel function solutions in range. These solutions reveal a minimum, or "cut-off" frequency, or the maximum wavelength that will propagate in a waveguide. In this talk, we will apply two sets of boundary conditions. The first involves two rigid boundaries where acoustic waves reflect from the top and bottom of a waveguide. Our second example will have an absorbing bottom in which there will be a lower cutoff frequency but becomes more similar to the rigid waveguide as frequency increases.

3:20–3:35

Geometric Brownian Motion, a Safe Assumption?

Andrew Snyder-Beattie and Kevin Groat
University of Mary Washington

Models for pricing of financial derivatives hinge on a number of assumptions, foremost among them being that the price of an underlying asset follows geometric brownian motion (GBM). While this assumption provides a solid framework for option pricing analysis, trends in historical data sometimes deviate from GBM. We will discuss some remarkable downturns and will explain these deviations. Our analysis will include illustrative examples and will offer insight into alternative approaches to GBM.

3:40–3:55

Chlorine Transportation Risk Analysis

Dennis Howell and Sara Miller
Towson University

We were asked to develop a model to quantify and explore methods of reducing the risk associated with transporting chlorine along roadways in the continental United States. In this presentation, we will discuss the development and application of a linear programming model to estimate the current chlorine transportation pattern and design a pattern that minimizes risk in the Mid-Atlantic region of the United States. We plan to discuss the necessary assumptions and the calculation of both cost and risk coefficients and provide some analysis of the effects of changing the supply constraints.

MAA Session #16

Room: Conference C **2:00P.M. – 3:55P.M.**

2:00–2:15

Segmentation Image Analysis: A Novel Approach to Identifying Cryptic Species

Christopher Lemon
Clarkson University

It is common practice in the field of evolutionary biology to distinguish among species based on unique physical characteristics. Regarding the lizards in the genus *Calotes*, it is often difficult to distinguish these defining characteristics visually, also known as a cryptic species complex. Given a library of images of sample lizards, we use various segmentation techniques based on partial differential equations to analyze geometric relationships and characteristics such as curvature within the image. This approach, when compared alongside DNA analyses of the sample lizards, will help develop a stronger understanding of what features can be used to determine a species within the genus.

2:20–2:35

Mathematically Modeling Risk Based Decision Making in Jays and College Students

Marie Rogers
Clarkson University

Blue Jays (Cyanocitta cristata) often pickup and visually scan multiple unshelled peanuts before deciding on one to take and store. Humans perform a similar process when trying to pick the best piece of produce in a grocery store; the goal being to obtain the best piece of produce while not spending hours and hours searching. Previous studies have analyzed decision making in western scrub-jays (Aphelocoma californica, a bird related to the blue jays) by comparing nut sampling data with three different decision strategies, ultimately concluding that a statistical model known as Comparative Bayes best describes the birds' strategy. In this study, we induced risk in analogous situations for blue jays and humans and mathematically modeled their behaviors to gain an understanding of how or if their strategies change while under risk. Using the models we compared and contrasted blue jays to humans to decide who can make more economical choices when presented with objects of different value while under the duration of risk: blue jays or humans.

2:40–2:55

Bridge and Superbridge Index for Knots

Stephanie Jensen
Williams College

The bridge index of a knot was introduced in 1954 by Schubert and has proved to be a very useful invariant for knots. It counts the least number of local maxima for the knot. It was generalized in 1985 by Kuiper to the superbridge index. This generalization has allowed for the determination of stick number for many knots, which is the least number of sticks glued end-to-end to create a given knot, and which is of interest to synthetic chemists. We will discuss our recent results on these invariants. No background assumed.

3:00–3:15

Generalizing the Crossing Number of Knots

Kyler Siegel
Columbia University

One of the oldest quantities associated to a knot is the least number of crossings in any projection of the knot. In this talk, we will discuss generalizations to the supercrossing number and the average crossing number and relate those to other well-known invariants. No particular background assumed.

3:20–3:35

Indicatrices of Knots

Liyang Zhang
Williams College

A knot is a simple closed curve in space, and as such, we can apply the tools of differential geometry to it. In particular, we can generate from it the tangent indicatrix (tantrix) , the normal indicatrix (notrix) and the binormal indicatrix (binotrix), three curves on the unit sphere. Using these curves, we can say much about the knot with which we started. We will see lots of pictures of these curves and no particular background is assumed.

3:40–3:55

Knots in the Cubic Lattice

Thomas Crawford
Williams College

One would like to understand knots that are restricted to lie in the edges of the cubic lattice. How many sticks does it take to make a given knot? What happens with the standard knot invariants like crossing number, curvature, and writhe, when a knot lies in the cubic lattice? We will discuss recent results.

MAA Session #17

Room: Carnegie III **2:00P.M. – 3:55P.M.**

2:00–2:15

Equal Circle Packings on a Torus

Brandon Tries and Jonathan Watson
Salem State College and University of Michigan

The study of maximally dense packings of disjoint equal circles into various containers has developed over the past forty years. The optimal densities and arrangements are known for many packings of small numbers of equal circles into hard boundary containers, including squares, equilateral triangles and circles. In this presentation, we will explore packings of small numbers of equal circles into a boundaryless container called a flat torus. Using numerous pictures, we will introduce all the basic concepts (including the notion of a flat torus, an optimal packing and the graph of a packing), demonstrate many maximally dense arrangements, and outline the proofs of their optimality. This work was done at the Grand Valley State University REU.

2:20–2:35

Rational Points on Quadric Surfaces

Jonathan Weisbrod
Rowan University

A quadric surface is a D-dimensional hypersurface in $(D + 1)$-dimensional space defined as the locus of zeros of a quadratic polynomial. When all D components of a point are rational, the point is contained in a rational number field on the surface. To obtain these points, we solve the quadratic polynomial as a Diophantine equation. The solutions display numerous patterns among their components and the relationship between various types of quadric surfaces is remarkable.

2:40–2:55

Minimal Surface Transformations

Ryan Viertel
Brigham Young University

Minimal surfaces in $\mathbb{R}^3$ are surfaces whose mean curvature vanishes at each point on the surface. Thus, minimal surfaces look like saddle surfaces and can be modeled by soap films spanning a wire frame. We can parametrize minimal surfaces by using the classical Weierstrass representation. In this talk we will discuss how one to one complex-valued harmonic mappings can be used with the Weierstrass representation to parametrize minimal graphs in $\mathbb{R}^3$. We will then use the shearing technique developed by Clunie and Sheil-Small to construct a harmonic mapping that lifts to a minimal surface under the Weierstrass representation. Varying a parameter of this mapping results in a continuous transformation of Scherk's first surface with $2n$ ends to a minimal surface with n helicoidal ends. Each of the intermediate surfaces and their conjugates will be embedded minimal surfaces.

3:00–3:15

Geometry of Surfaces with Densities

Michael Mara

Williams College

Perelman's stunning proof of the million-dollar Poincar Conjecture needed to consider not just manifolds but "manifolds with density" (like the density in physics you integrate to compute mass). We explore some basic geometry of such spaces.

3:20–3:35

Non-regular Polytope Numbers

Peter Jantsch and Doug Smith

Grove City College

Polytope numbers are sequences of positive integers based on the geometry of a polytope in d-dimensions. The polygonal numbers are well known and quite easily found. Likewise, mathematicians have derived formulas for the regular polytopes and their cross products. However, little is known about forming polytope numbers for other higher dimensional shapes. Using an inductive method of construction outlined by HK Kim, we will associate polytope numbers to several other uniform polytopes, specifically the rectified regular simplex, and demonstrate problems for future research.

3:40–3:55

The Geometry of Compact Sets

Sebastian Sanchez and Jonathon Verwys

New Mexico State University and Grand Valley State University

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, Sebastian Sanchez and Jonathon Verwys. participants in the Grand Valley State University Research Experiences for Undergraduates program, will present the results of their investigations into the geometry of compact sets of n dimensional real space, with emphasis on properties of betweenness and the trigonometry of this space.

PME Session #7

Room: Phipps **2:00P.M. – 3:55P.M.**

2:00–2:15

Properties of Lipschitz Continuous Functions in Lipschitz Function Algebras

Ryan Northrup

Clarkson University

Convergence criteria for general continuous functions and Lipschitz functions differ. Unlike general continuous functions, uniform limits of Lipschitz functions need not be Lipschitz. We analyze series of Lipschitz functions with different convergence benchmarks. This talk describes a method to construct and verify Lipschitz functions that fulfill a specific property.

2:20–2:35

Level Sets and Non-Real Zeros of Real Entire Functions of Finite Order

Jessalyn Bolkema

Hope College

We use the level sets $\{z \in H^+ : \operatorname{Im} Q(z) = 0\}$ to count the non-real zeros of derivatives of functions of the form $f(z) = P(z)e^{K(z)}$ where P, K are real polynomials and Q is the Newton's method function for f.

2:40–2:55

Progress on the Monotonicity Conjecture

Nathan Graber

Hope College

In 1943, G. Polya conjectured what the number of non-real zeros of real entire function of order greater than 2, with finitely many non-real zeros, the number of non-real zeros of the nth derivative tends to infinity as $n \to \infty$. This was solved in 2005 by A. Eremenko and W. Bergweiler. A natural extension is whether the number of non-real zeros of the nth derivative increases monotonically as $n \to \infty$. We discuss our progress on this conjecture.

3:00–3:15

Harmonic Measure Distribution Functions in Complex Domains

Kevin Gerstle

Kenyon College

The harmonic measure distribution (HMD) function of a complex domain relates the shape of the domain to the behavior of a Brownian particle inside the domain. We will show how an HMD function can be calculated and discuss the information such a function gives about its domain.

3:20–3:35

On the Maximality of the Bernstein Polynomials

Christopher Schafhauser

University of Wisconsin - Platteville

Consider the class of monic polynomials, Q, with degree n, with all roots on the interval $[a, b]$ such that for all $p \in Q$, $p(a) = p(b) = 0$. We examine exactly which polynomial in Q has the largest L^p norm for all $p \geq 1$, and show how changing the position of a single root effects the norm of the polynomial.

3:40–3:55

Putnam Problem A1: A Review and Variation of Functions on Squares in a Plane

Mario Sracic

Youngstown State University

From the 2009 Putnam Exam, we will consider problem A1: "Let f be a real-valued function on the plane such that for every square $ABCD$ in the plane, $f(A) + f(B) + f(C) + f(D) = 0$: Does it follow that $f(P) = 0$ for all points P in the plane?" By first reviewing a simple solution to the problem, we will then consider whether the problem can hold for squares of integer side length and determine if there exists a real-valued function, $f : \mathbb{R}^2 \to \mathbb{R}$ that is *not* identically 0 for all P . In the process, we discover an interesting property of squares in the plane under the function.

PME Session #8

Room: Oliver **2:00P.M. – 3:55P.M.**

2:00–2:15

Knot Mosaics: Results and Open Questions

Erica Evans
Denison University

In 2008, Lomonaco and Kauffman defined a knot mosaic as a way of depicting knots on an $n \times n$ matrix consisting of 11 different predetermined 1×1 tiles. This presentation will explore results on the mosaic number, the smallest integer n required to fit a given knot on an $n \times n$ board, and the crossing number. This presentation is intended for a general audience.

2:20–2:35

Putting Numbers on the Board: Enumeration of Knot Mosaics

Joseph Paat
Denison University

Lomonaco and Kauffman defined the notion of a knot mosaic to be an $n \times n$ mosaic board constructed from a basis set of 11 tiles. They showed that 21 different knots could be presented on a 3×3 mosaic board. We further this result by tabulating the number and types of knots found on an $n \times n$ mosaic board. This talk is intended for a general audience.

2:40–2:55

Pell's Equation and Quadratic Non-residues

Kaylee Sutton
John Carroll University

The equation $y^2 - nx2 = \pm 1$ is Pell's Equation. When n is an odd prime, the theory of quadratic resides and non-residues applies or can give insights to solutions.

3:00–3:15

Flexibly Planar and Flexibly Flat Graphs

Alexander Murray
SUNY Potsdam

A graph G is flexibly planar if, for any cycle C in G, there is a planar embedding of G for which C bounds a disk that meets G only along its boundary. The property of a graph being flexibly flat is a 3-dimensional analog. In this talk we discuss flexibly planar and flexibly flat graphs.
This is a joint talk with Lydia Garcia of St. Mary's College and Peter Bonventre of Union College. This work was completed during the summer 2010 SUNY Potsdam/Clarkson REU program.

3:20–3:35

An Elementary Construction of the Convex Regular Polytopes of Every Dimension

Thomas Eliot
Willamette University

The Platonic Solids are beautifully symmetric 3-dimensional objects that are easily generalized to all dimensions. We shall use them to explore every dimension, from 2 to 5 and beyond, with an emphasis on visualizing their 4th dimensional versions. This talk will be accessible to students of any background.

3:40–3:55

Patterns in Primitive Pythagorean Triples

Michael Joseph
John Carroll University

We will find and prove patterns of divisibility by small primes in primitive Pythagorean triples.

MAA Session #18

Room: Conference B **4:00P.M. – 6:15P.M.**

4:00–4:15

Modeling Ecosystem Carbon Uptake using Wavelet Analyses

Jeremy Anthony and Nick Hudson
Augsburg College

Understanding the terrestrial carbon cycle in global ecosystems is critical to understand their responses to anticipated climate change. Wavelets are a mathematical tool which can be used to analyze a time series of continuous measurements. For this study, wavelets were used to analyze the measurements of carbon uptake and other meterological measurements (temperature and humidity) in five separate ecosystems. Wavelet analyses revealed carbon uptake correlations to these environmental measurements across different timescales (daily and seasonal). This presentation will highlight the use of wavelet analysis in environmental mathematics.

4:20–4:35

Analysis of Ecosystem Carbon Uptake using the 2nd Fundamental Theorem of Calculus

Nana Owusu and Jazmine Darden
Augsburg College

Significant advances in the field of Environmental Science have shown that there is an imbalance in the rate at which biospheric and oceanic sinks remove CO_2 from the atmosphere. That imbalance is partly the cause of the abnormal rise in atmospheric CO_2 due to anthropogenic sources. Our research objective was to understand patterns of net carbon uptake and environmental variation across a variety of ecosystems. To perform our analysis we acquired data via FLUXNET, which is a global database of 502 substations on six continents. We downloaded half-hourly carbon uptake data from five stations in different biomes. These data were analyzed to determine the daily carbon uptake by applying the Second Fundamental Theorem of Calculus. Our presentation will illustrate our results as a synthesis across these five sites.

4:40–4:55

Theoretical Versus Computational Methods for Analyzing Climate Data

Clarice Dziak
Clarkson University

Theoretical and computational methods are available for finding temporal patterns and trends in climate data such as precipitation, temperature and tree ring measurements. Two theoretical methods - Linear Regression and the Fourier Transform - are easily-interpreted and mathematically-justified techniques for extracting trends and periodicities but do not always successfully pull out the appropriate information from the signals. The Mann-Kendall Trend Statistic and Empirical Mode Decomposition are computational methods that can extract trend and period information but are not necessarily mathematically justified and can be difficult to interpret. Comparing and contrasting the two approaches demonstrates their abilities to produce applicable results for climate analysis.

5:00–5:15

Bio-Math Mapping and Water Quality Analysis of Gowanus Canal

Renee Clarke

CUNY-New York City College of Technology

Students will collect water samples from six different sites along Gowanus Canal. The epidemiologic research goals of the study are as follows: 1. to collect data on the total number of bacteria per 100 ml of water. 2. To determine the number of fecal coli forms for Gowanus Canal. 3. To determine the antibiotic resistant bacteria (ARB) from the total cultivable bacteria and from the coli forms. The Mathematical objectives for this study are as follows: 1. to determine the ratio of antibiotic resistant bacteria (ARB) to the total cultivable bacteria and the ratio of ARB's to the total *E. coli* bacteria. 2. To analyze water quality of this waterway using the total counts of cultivable bacteria, *E. coli*, and ARB population. Linear regression analysis will be performed between antibiotic resistance and fecal coli forms and also between antibiotic resistance and *E. coli*. Box and whisker plot are used to compare bacterial population measurements collected on Gowanus Canal. In addition, a comparative water quality analysis will be performed with the Hudson River using statistical t-test.

5:20–5:35

Optimizing Aquifer Water Consumption and Maximizing Profit for Strawberry Farmers

Mark Minick

Clarkson University

In the past decades, Pajaro Valley in California has been undergoing a severe seawater intrusion problem. As one of the major industries in the valley, berry farming, is believed to be the main cause for seawater intrusion due to its heavy use of groundwater for irrigation purpose. While the berry farmers are trying to stay profitable with the increasing water price due to additional seawater treatment, it is important and necessary to look for ways to reduce the water drafting from the endangered aquifer. In this work, we mathematical modeled an artificial berry farm with realistic parameters and constructed an optimization framework where we minimize the total aquifer draft and maximize the profits. Several methods of conservation are incorporated in the current model, including crop rotation, runoff collection, land retirement and dry farming.

5:40–5:55

Self-formation and Patterns of Arid Ecosystems

Nghiep Huynh

Augsburg College

The relationship between vegetation and rainfall is very important in spatial self-formation of arid ecosystems. In this study, we modify a mathematical model presented by Jost von Hardenberg et al. [2001, Physical Review Letters]. That particular model examines vegetation patterns found in nature by including the natural adaptation of plants to scarcity of water and the consequent seasonal variation in their growth rate. We observe and analyze the patterns dependence on the duration of seasons' annual precipitation showing how seasonality affects spatial self-organization. The long term objective of the model is to propose explanations such as how long an effective area of land will be changed from its original ecosystem to an arid ecosystem. In conclusion, understanding this dynamic relationship contributes to understanding of self-formation of arid ecosystems.

6:00–6:15

Bio-Math Mapping and Water Quality Analysis of Hudson River

Steven Lora, YiMing Yu, Jodi-Ann Young, and Jiawen Yu
City University of New York

The Bio-Math Mapping is an interdisciplinary research project, combining mathematics with epidemiology, microbiology and environmental studies. The Clean Water Act (CWA) initiates a process for States to measure and collect information on water quality . The level of fecal coli forms present in water, including *E. coli*, is one of the most common measures of water quality. Students will collect water samples from six different sites along the Hudson River. The epidemiologic research goals of the study are as follows: 1. to collect data on the total number of bacteria per 100 ml of water. 2. To determine the number of fecal coli forms for Hudson River. 3. To determine the antibiotic resistant bacteria (ARB) from the total cultivable bacteria and from the coli forms. The Mathematical objectives for this study are as follows: 1. To determine the ratio of antibiotic resistant bacteria (ARB) to the total cultivable bacteria and the ratio of ARB's to the total *E.coli* bacteria. 2. To analyze water quality of this waterway using the total counts of cultivable bacteria, *E.coli*, and ARB population. Linear regression analysis will be performed between antibiotic resistance and fecal coli forms and also between antibiotic resistance and *E. coli*. Box and whisker plot are used to compare bacterial population measurements collected on the Hudson River. A comparative water quality analysis will be performed with Gowanus Canal using statistical t-test.

MAA Session #19

Room: Conference C **4:00P.M. – 6:15P.M.**

4:00–4:15

Stick Numbers for Alpha-Regular Unknots

Christopher Dubbs
Lock Haven University of Pennsylvania

In this talk we will define a mathematical knot, introduce the concepts of stick numbers and alpha-regularity, and examine the stick number of various knots. More specifically, we will examine the stick numbers for alpha-regular unknots. By presenting the cases of the unknot where the stick number is 3, 4, and 5, we will introduce a procedure of determining the stick number of the unknot for any given alpha value.

4:20–4:35

Stick Numbers of Knots

Michelle Chu
Emory University

The stick number of a knot is the least number of sticks glued end-to-end to construct the knot. It is of great interest to synthetic chemists, who would like to synthesize knotted molecules, and who model the bonds between the atoms of a molecule by sticks. We will discuss what was previously known about stick numbers and recent results.

4:40–4:55

Knot Mosaics and Mosaic Number

Jacob Shapiro
Denison University

In their 2008 paper, Lomonaco and Kauffman defined a system for representing knots on $n \times n$ boards using square mosaic tiles. The mosaics are built from 11 predetermined 1×1 tiles. Lomonaco and Kauffman also defined the mosaic number of a knot as the size n of the smallest $n \times n$ board on which the knot can be realized. This presentation will cover results obtained on mosaic number and connections between mosaic number and other knot invariants, such as crossing number. The presentation is intended for a general audience.

5:00–5:15

Planar Isotopy and Tight Knot Diagrams in Hexagonal Knot Mosaics

Andreana Holowatyj
Benedictine University

An n-ring hexagonal grid consists of a regular hexagon surrounded by n adjacent concentric rings of regular hexagons. A hexagonal knot mosaic is a knot diagram that lies in an n-ring hexagonal grid in a particular way such that the intersection of the knot diagram and the interior of one of the hexagons is one of 27 basic types. We enumerate planar isotopies of hexagonal knot mosaics in a 2-ring hexagonal grid. A tight hexagonal knot mosaic is one such that the knot diagram cannot be contracted to a diagram of shorter length via planar isotopy. We then enumerate the tight hexagonal knot mosaics for some knots in a 2-ring hexagonal grid.

5:20–5:35

Random Walks on the 2-dimensional Comb Lattice

Nakisa Nassersharif
Syracuse University

In this talk we study the behavior of a simple random walk $S_n = (x_n, y_n)$ on $\mathbb{Z}^2$ with a probability transition function given by: $P(S_{n+1} = (x_{n+1}, y_{n+1})|S_n = (x_n, y_n))) = p$ if $y \neq k$ and $P(S_{n+1}) = (x \pm 1, k)|S_n = (x, k)) = P(S_{n+1}) = (x, \pm 1)|S_n = (x, k)) = q$, where $p + 2q = 1$, $k = 0, 1, 2, \ldots$ For $k = 0$, $p = 1/2$ and $q = 1/4$, the expected distances of the horizontal and vertical components of S_n reached in n steps are known to be of order $n^{1/4}$ and $n^{1/2}$ respectively. For other values of k, p and q, we will analyze the behavior of S_n and give asymptotic results for the expected distances by time n. Further we will discuss the recurrence/transience behavior of such walks.

5:40–5:55

Retention Data Analysis Using Markov Chain Method

Delcan Mallamo
Seattle Central Community College

This project sets out to perform a logistic regression analysis on a dynamical system. The intended data pertains to the persistence of students involved in various science and math course sequences as they progress over five years, and a Markov chain is used to model the distribution of the system's progression. The stochastic system is assumed to show trends and fluctuations from numerous student attributes. These attributes shift as the study progresses over time, and patterns can be found by doing a probability study at each scholastic quarter to identify the overall trend of student participation. Progress through the respective programs is monitored by associating states based on criteria inherent to all students, rated on each individual's decision to either take the next class, repeat class, or cease taking class. A Hidden Markov Model is explored for possible cases of unobserved states, such as if a student took a class at another college that is not directly reflected in the data. State-transitioning is then analyzed for data retention purposes. A generalized linear model, done on "R", is used to give an overview on how the state transition percentages change over time. The methodology is first explored using a mock-up set of data created using a random number generator function to produce the progress states simulating the actual data, which is still pending.

MAA Session #20

Room: Carnegie III **4:00P.M. – 6:15P.M.**

4:00–4:15

Minimal Surfaces and Planar Harmonic Mappings

Amanda Curtis and Rachel Messick
Wellesley College and Brigham Young University

A minimal surface in $\mathbb{R}^3$ is a regular surface for which the mean curvature equals zero at every point. In the theory of minimal surfaces, theWeierstrass representation provides a formula using complex analysis for the local representation of a minimal surface. One new approach to investigating minimal surfaces is to use results about planar harmonic mappings, $f = h + \bar{g}$, where h and g are complex analytic functions. In particular, we can reformulate the classical Weierstrass representation using the harmonic univalent map $f = h + \bar{g}$.We will discuss some results about minimal surfaces by using theorems about planar harmonic mappings.

4:20–4:35

Cayley Maps of Circulant Graphs on Orientable Surfaces

Ashley Toth
Rollins College

Given a group G and an ordering of a generating set S closed under inverses, one can use the corresponding Cayley map to describe an embedding of a graph onto an orientable surface. The ordering dictates the local behavior of the embedding about each vertex. A dart is defined to be an ordered pair $(g, x) \in G \times S$, and each face, or distinct region of the surface, corresponds to a list of darts having certain properties. A map for which every face has the same number of darts is called face-regular. A complete face-regular map is a map for which every face includes every element of the set S exactly once as the second coordinate of a dart. In this paper, some results about the relationship between the ordering of the set S and the graph are stated and proven with the goal of characterizing complete face-regular maps.

4:40–4:55

The $(n + 1)$-Volume of an n-Torus

Luke Serafin
Coe College

A torus is a (two-dimensional) surface generated by the rotation of a circle about a larger circle which lies in a plane orthogonal to the first. The concept of an n-torus is a generalization of the concept of a torus (or 2-torus) to n dimensions. An n-torus is a hypersurface in $(n + 1)$-space generated by the rotation of an $(n - 1)$-sphere (the locus of all points equidistant from a particular point in n-space) about a circle which lies in the plane containing its center and orthogonal to the hyperplane determined by the $(n - 1)$-sphere. In this presentation we shall see how the first theorem of Pappus is used to compute the volume contained by a closed surface of revolution, and how this theorem can be generalized to n-dimensions. Finally, we shall apply this result to find the $(n + 1)$-volume of an n-torus in terms of its major and minor radii, with the $(n + 1)$-volume of an n-sphere being an intermediate result.

5:00–5:15

Generalized Monotone Method for Caputo Fractional Differential Equations

Thanh-Hoa Pham
University of Louisiana at Lafayette

Monotone method combined with upper and lower solutions is a fruitful technique to prove the existence of extremal solutions for dynamic systems. However, the method is applicable when the forcing function can be made increasing by the addition of a linear term or it is decreasing in the dynamic system. In this work, we prove the existence of coupled minimal and maximal solutions by generalized monotone method for Caputo fractional differential equations. In this case, the forcing function is the sum of an increasing and decreasing functions which is in general true for population models and chemical combustion. We will obtain numerical results to demonstrate the application of our theoretical results to Lotka-Volterra type model.

5:20–5:35

Modeling Blood as a Micromorphic Fluid

Melanie Vining
Coastal Carolina University

Blood is a non-Newtonian fluid on which several living processes depend. Blood in general is considered a micromorphic fluid. Simply put, a micromorphic fluid is one whose behavior is affected by local material movements of its surrounding volume element. Blood flow can be observed on three scales of observation: the microscale, on which the differences between a red blood cell and other constituents of blood are distinguishable, the mesoscale, on which the differences between blood and the surrounding tissue are distinguishable, and the macroscale on which there are no differentiable components. A macroscale model for for microcirculation can be obtained by using a volume-averaging technique to upscale conservation equations and exploiting the second law of thermodynamics. The resulting constitutive equations are given herein. The result is a system of 28 field equations in 28 unknowns.

5:40–5:55

Soap Bubbles: A Metacalibration Approach

Joan Madsen and Katelynn Kochalski
Brigham Young University and Canisius College

In the past two hundred years, mathematicians have been studying soap bubbles. One of the major problems in this field is to minimize perimeter, or surface area, while holding area, or volume constant. Here we will use metacalibration, a new optimization technique, to prove results about soap bubbles and other related problems.

6:00–6:15

A Beckman-Quarles Type Theorem for Linear Fractional Transformations

Andrew Mis and Josh Keilman
Calvin College

It is obvious that a rigid motion of Euclidean space preserves pairs of points a unit distance apart. Beckman and Quarles proved the converse. In this presentation we consider the problem of characterizing maps that preserve pairs of hyperbolas in the double plane separated by an invariant distance of one.

J. Sutherland Frame Lectures

2010	Nathaniel Dean	*Incomprehensibility*
2009	Persi Diaconis	*The Mathematics of Perfect Shuffles*
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, the American Statistical Association, 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 subsistence grants to Pi Mu Epsilon speakers.

MAA Lectures for Students

2010	Sommer Gentry	*Faster, Safer, Healthier with Operations Research*
2009	Colm Mulcahy	*Mathemagic with a Deck of Cards on the Interval Between 5.700439718 and 806581751709438785716606368564037 669752895054408832778240000000000000*
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*

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In Memory of

Dr. Leo J. Schneider

John Carroll University

National Pi Mu Epsilon Secretary-Treasurer

Pi Mu Epsilon Secretary-Treasurer Leo J. Schneider died suddenly on June 6, 2010. We will miss him terribly. Professor Schneider ran Pi Mu Epsilon practically single-handedly and to many mathematicians and students around the country he *was* Pi Mu Epsilon. He was involved in every aspect of the organization and worked tirelessly to keep information flowing between the Council, the Chapters, and the mathematics community, performing these tasks in a way that made the job look easy.

Leo graduated from Xavier University in Cincinnati with both a bachelor's and a master's degree in mathematics. After two years in the Army Ordnance Corps, Leo joined the faculty of John Carroll University in 1963, where he attained the rank of Professor in 1979. Leo earned his Ph.D. degree in mathematics at Case-Western Reserve University in 1971, having taken a two-year leave from JCU to complete his dissertation research in differential equations. Leo then served as Department Chair from 1971 to 1979.

Since early in his career, Leo took a special interest in national mathematics competitions. From 1974 to 1988, Leo served as Ohio's regional exam coordinator for the American High School Mathematics Exam, and was appointed to the national American Mathematics Competitions Committee in 1980. During the period from 1988 to 1994, he chaired that committee. Under his leadership, the scope of national competitions expanded to include a competition for junior high school students, and an invitational competition for students who scored highly on the AHSME. During these years, Leo gained a reputation as one of the country's premier mathematical problem posers, which led to numerous requests for his participation in the creation and judging of various other regional mathematics competitions.

Leo had been an active member of the Mathematical Association of America, serving a one-year term as President of the Ohio Section of the MAA, and a three-year term as Governor of the Ohio Section. In 2004, he was awarded the Ohio Section's Award for Distinguished College or University Teaching.

In spite of all of his professional activities, Leo also found time for relaxation, including attending Cleveland Orchestra concerts, playing bridge, bicycling, cross-country skiing, and perhaps his fondest avocation–traveling. Leo will always be remembered for his approach to all of his activities: he approached everything he did with boundless energy and the utmost enthusiasm.