Program of Activities
For the Spring Meeting of the

Mathematical Association of America

Ohio Section

Spring 2008
Marietta College
Marietta, Ohio
April 11-12, 2008

MAA Ohio Section

Program

Friday, April 11, 2008

Noon – 4:30	Registration	McDonough 3rd Floor Gallery
1:00 – 4:30	Vender and Book Exhibits	McDonough 3rd Floor Gallery
12:00-1:20	Student Competition	Andrews 203,(201,205,301)
12:15 – 1:15	Committee Meetings: CONCUR CONSACT CONTEAL	 McDonough 207 McDonough 206 McDonough 208
1:30 – 1:45	Welcome and Announcements	McDonough 131
1:45 – 2:45	Invited Address **"Insights from Archimedes"** Bill Higgins, Wittenberg University	McDonough 131
2:45 – 3:15	Break/Refreshments	McDonough 3rd Floor Gallery
3:15 – 4:15	Invited Address **"Infinity Bottles of Beer on the Wall "** Lew Lefton, Georgia Tech	McDonough 131
4:25 – 6:20	**Contributed Papers**	Rickey 141,143,162,238,239
4:25 – 6:20	Executive Committee Meeting	McDonough 110
6:30-8:00	Student Pizza Party and Graduate School Panel Discussion	Thomas 124
6:20 – 6:45	Social Time	Andrews 203
6:45 – 8:00	Banquet	Andrews 203
8:10 – 9:00 After-Dinner Talk	**"The Covering Congruences of Paul Erdos"** Carl Pomerance, Dartmouth College	McDonough 131
9:00	**Business Meeting and Presentation of Teaching Award**	McDonough 131

Saturday, April 12, 2008

8:00 – 10:15	Registration	McDonough 3rd Floor Gallery
8:00 – 10:15	Vendor and Book Exhibits	McDonough 3rd Floor Gallery
8:00 – 8:50	Coffee and Pastries	McDonough 3rd Floor Gallery
8:05 – 8:40	Liaisons' and Department Chairs' meeting	McDonough 214
8:05 – 8:40	Executive Committee Meeting	McDonough 110
8:50 – 8:55	Announcements	McDonough 131
8:55 – 9:55	Invited Address **"Euler's Function"** Carl Pomerance, Dartmouth College	McDonough 131
9:55	Announcement of Student Competition Winners	McDonough 131
9:55 – 10:15	Break/Refreshments	McDonough 3rd Floor Gallery
10:25 – 11:25	Roundtable Discussion **"Assisting Education Departments with Accreditation"**	Rickey 285
10:25 – 11:40	**Contributed Papers**	Rickey 141,143,162,238,239
11:50 – 12:50	Invited Address **"Distributed Computing and the Internet"** Lew Lefton, Georgia Tech	McDonough 131
12:50	**Closing Remarks**	McDonough 131

Abstracts of Invited Addresses

Friday

Speaker: Bill Higgins
Title: *Insights from Archimedes*
Abstract: Archimedes of Syracuse is sometimes referred to as the most important scientist who ever lived. Both the mathematics of infinity and the application of mathematical models to the physical world are principles developed by Archimedes that went on to influence the course of modern science. We will look at some of Archimedes' results and discuss how his works have been passed down to us from his time – more than 2200 years ago. Scholars are, in fact, currently gaining new insight into Archimedes' work by using modern imaging technology to analyze a recently rediscovered manuscript, called the Archimedes Codex palimpsest, which contains the faint image of a tenth century copy of Archimedes' work behind the script of a thirteenth-century monk's prayer book.

Speaker: Lew Lefton
Title: *Infinity Bottles of Beer on the Wall - or What's so Funny about Mathematics*
Abstract: In addition to being a mathematician, Dr. Lefton has worked as a standup and improv comedian. Of course, this means that he's funny, and he can prove it! This talk will be a stand up comedy set consisting of original material based on Lefton's experiences as a graduate student, professional mathematician, and college professor. WARNING: This presentation will include certain portions of Lefton's material that are only suitable for mathematically mature audiences! Come and steal his jokes for use in your classrooms!

Speaker: Carl Pomerance
Title: *The covering congruences of Paul Erdos*
Abstract: Can the integers be expressed as the union of finitely many residue classes to different large moduli? This deceptively simple question was raised by Paul Erdos over 50 years ago and it is still unsolved. Erdos wrote of this as his ``favorite problem," which is saying something given the enormous number of great problems due to him. In this talk I will discuss the origins of the problem and its connections to some other famous unsolved problems, as well as some very recent numerical and theoretical progress.

Saturday

Speaker: Carl Pomerance
Title: *Euler's Function*
Abstract: A familiar concept in elementary number theory and algebra, Euler's function at n is the number of integers from 1 to n that are relatively prime to n. It is not only crucial to the RSA cryptosystem, Euler's function is a surprisingly rich source of interesting problems, some of them still unsolved. For example, is it always at least 2 to 1 as a mapping from the natural numbers to themselves? What is the computational complexity of computing Euler's function? Is there an asymptotic formula for the distribution of its range within the natural numbers? These, and many more problems and results will be discussed.

Speaker: Lew Lefton
Title: *Distributed Computing and the Internet: Why your computer should be spending most of it's time doing mathematics*
Abstract: In this talk we will take a look at different ways that mathematics is done using computers. We will discuss some large scale distributed computing projects like GIMPS (Great Internet Mersenne Prime Search), as well as other mathematical computing efforts, including some pure and applied mathematical computations on which the speaker is currently working.

Brief Biographies of Invited Speakers

Bill Higgins, Wittenberg University

Bill Higgins is a 1976 graduate of Kenyon College with majors in math and physics and graduated from the University of Notre Dame in 1982 with a Ph.D. in mathematics under the direction of Warren Wong. Bill joined the Wittenberg University faculty in 1984.

Bill served as the Ohio Junior High School (AMC 8) American Mathematics Competition Director from 1986-2004 and served as a member of the editorial board of the MAA Classroom Resource Materials book series from 2004 to 2006. He is currently a member of the editorial board of the new MAA Textbook Series.

Bill has served the Ohio Section as a member of CONSACT, as co-editor of the section newsletter, and as a member and then chair of the program committee. He is now near the end of his term as President of the Ohio Section. Bill was awarded the Ohio Section MAA outstanding teaching award in 2007.

While on leave from Wittenberg, Bill has taught at the Naval Postgraduate School and at the United States Military Academy at West Point. He and his wife, Aparna Higgins who teaches mathematics at the University of Dayton, are currently planning to spend sabbatical leaves at California State University Channel Islands (CSUCI) during the 2008-09 school year. CSUCI is not actually located on the Channel Islands, but is on the mainland between Los Angeles and Santa Barbara about 5 miles from the Pacific Ocean.

Lew Lefton, Georgia Institute of Technology

Lew Lefton received his Ph.D. in Mathematics from the University of Illinois in 1987. After visiting for two years at the University of California at Riverside, he took a position in the mathematics department at the University of New Orleans. In 1999, he moved to Georgia Tech where he is currently the Information Technology Director for the School of Mathematics and the College of Sciences. Lefton's research interests are in scientific computing and applied mathematics. He is the author of many articles, and the textbook "Introduction to Parallel and Vector Scientific Computing."

In addition to his professional life in academia, Lefton enjoys performing stand up and improv comedy. He has performed around the country at dozens of clubs (the Improv, the Laugh Factory, Comedy Gumbo, Zanies, ...), colleges (University of Illinois, University of California Riverside, Georgia Tech, Loyola University, Harvey Mudd College, ...) and concerts (Three Dog Night, Bobcat Goldthwait, ...). His business card reads:

Lew Lefton
Mathematician/Stand Up Comic
"He's funny and he can prove it"

Carl Pomerance, Dartmouth College

Carl Pomerance received his B.A. from Brown University in 1966 and his Ph.D. from Harvard University in 1972 under the direction of John Tate. Currently he is a mathematics professor at Dartmouth College, after previous positions at the University of Georgia and Bell Labs. A number theorist, Pomerance specializes in analytic, combinatorial, and computational number theory, with applications in the field of cryptology. He considers the late Paul Erdos as his greatest influence.

Contributed Paper Sessions

Friday, April 11 *= student speaker

Time	Rickey 141 Session Chair Bill Friel	Rickey 143 Session Chair	Rickey 162 Session Chair	NOTES
4:25 – 4:40	***Arc Presentations: the (p,q)-torus Knot*** Abstract 1 Matt Steinke* Denison University	***The Venn-Brunnian Connection*** Abstract 2 Ashleigh M. Stelter* Mount Vernon Nazarene College	***From the Slide Rule to the TI-Nspire*** Abstract 3 Cathy Stoffer Ashland University	
4:45 – 5:00	***Interdependencies of Bundle Forms*** Abstract 6 Robert D. Knight Ohio University - Chillicothe	***Wizarding Wisdom*** Abstract 7 Kate Plummer* Ashland University	***Cooperative Learning*** Abstract 8 Philip Blau Shawnee State University	
5:05 – 5:20	***J. Glaisher and Euler's Constant*** Abstract 11 Thomas P. Dence Ashland University	***Epidemiology on the Farm*** Abstract 12 Samuel J. Behrend* Denison University	***Precalculus at CSU*** Abstract 13 Ieda Rodrigues Cleveland State University	
5:25 – 5:40	***Solving Fermat's Equation for n=3*** Abstract 16 Olusegun M. Otunuga* Marshall University	***Markov Chains and the Ising Model*** Abstract 17 Christopher M. Lemon* Ohio Northern University	***Math Requirements for Teachers in Grades 4 through 9*** Abstract 18 Dick Little Baldwin Wallace College	
5:45 – 6:00	***The Structure of Digroups*** Abstract 21 Andrew Magyar* Ohio Northern University	***Modeling Competition among Species*** Abstract 22 Jonathan A Schilens* Cleveland State University	***Statistics Partnership: Math and Business*** Abstract 23 James A. FitzSimmons and Angela D Mitchell Wilmington College	
6:05 – 6:20	***Tarski's Circle-Squaring Problem Dissected*** Abstract 26 Jeffrey A. Willert* College of Wooster	***Sudoku: Math or No Math?*** Abstract 27 Rachel M. Cordy* Ashland University	***Bridging the Gap Between Algebra and Abstract Algebra*** Abstract 28 Erica D. Keene* and Ryan L. McDannell* University of Findlay	

Time	Rickey 238 Session Chair	Rickey 239 Session Chair Gary Lobo	NOTES
4:25 – 4:40	***Modern Cryptology Conundrums*** Abstract 4 Joanna R. Kreiselman* Denison University	***Conformal Mappings and Vector Fields*** Abstract 5 Harrison D. Potter* Marietta College	
4:45 – 5:00	***Difference Equations*** Abstract 9 Olwen Conant* Cleveland State University	***Investigating the Rotations of a Cube*** Abstract 10 Kendra L. Bruns* and Jeraco R Speelman* University of Findlay	
5:05 – 5:20	***Probabilities in the Game of RISK*** Abstract 14 Ryan Knobeloch* Mount Vernon Nazarene College	***Rational Approximation of Irrational Numbers*** Abstract 15 Brian J. Stewart* Cleveland State University	
5:25 – 5:40	***Hazard Rate Functions*** Abstract 19 Erika R. Mignogna* Cleveland State University	***Burnside's Theorem*** Abstract 20 Krista Foster* Youngstown State University	
5:45 – 6:00	***The Effective Condition Number*** Abstract 24 Tyler W. Drombosky* Youngstown State University	***How to Ride a Unicycle*** Abstract 25 John T. Noonan Mount Vernon Nazarene College	
6:05 – 6:20		***A True Baseball Fan*** Abstract 29 Kevin E. Jackson* Ashland University	

Contributed Paper Sessions

Saturday, October 27 ***= student speaker**

Time	Rickey 141 Session Chair Rich Daquila	Rickey 143 Session Chair	Rickey 162 Session Chair	NOTES
10:25 – 10:40	***Extending Integrable Mean Value Theorem*** Abstract 30 Christian James* Otterbein College	***Continuous Images of the Cantor Set*** Session Chair Abstract 31 Judith A. Palagallo University of Akron	***Probability Statistics*** Abstract 32 Alissa M. Douglas* Capital University	
10:25 – 10:40	***Alphametics*** Abstract 33 Jordan Job* Ashland University	***Intro to Degree Theory on R"*** Abstract 34 Damon F. Haught* Youngstown State University		
10:45 – 11:00	***Relativity & Mercury's Perihelion Precession*** Abstract 35 Jessica M. Schwan* Cleveland State University	***Generalized Fractal Curves*** Abstract 36 David M. Freeman* University of Cincinnati	***Binomial Coefficients from a Polynomial*** Abstract 37 Brian J. Ervin* Wittenberg University	Roundtable Discussion: *Assisting Education Departments with Accreditation*
10:45 – 11:00	***Musical Mathematics*** Abstract 38 Kimberly A. Alley* Ashland University	***Ramsey's Theorem to Home Search*** Abstract 39 Kajal Nag* Cleveland State University		
11:05 – 11:20	***Optimizing Quadratic Forms of the Unit Sphere*** Abstract 40 David R. Martin* Youngstown State University	***A Study of the Dice Game 10,000*** Abstract 41 Thomas E. Mayerchak* Cleveland State University	***Arithmetic Functions Evaluated at Factorials!*** Abstract 42 Daniel M. Baczkowski* University of South Carolina	
11:05 – 11:20	***The Abundancy Spiral*** Abstract 43 Judy A. Holdener Kenyon College	***Associative Memory: Hopfield Neural Network*** Abstract 44 Boris Kerkez Ashland University		
11:25 – 11:40	***Fundamental Solution of Dirac System*** Abstract 45 Wen Liu* Kent State University - Stark	***Markov Transition Matrices*** Abstract 46 Moriah E. Wright* Youngstown State University	***Doubly Stochastic Matrices*** Abstract 47 M.B. Rao University of Cincinnati	

Abstracts of Contributed Papers

Friday 4:25 – 4:40

A New Way to Look at Old Knots: Arc Presentations for the (p,q)-torus Knot

Matt Steinke
Denison University

Abstract 1: How can you tell two knots apart (hint: Scout training is not a prerequisite)? A knot's arc index is one of many invariants used to distinguish different knots. In this talk, we'll define the arc index of a knot and, more generally, the knot's arc presentation. We'll also consider how to make an arc presentation for a given knot. Then we'll take a specific look at the arc presentations of (p,q)-torus knots-those knots that fit nicely around a donut-shaped surface-hoping to find an interesting result for their arc index. Be ready to put your mind's eye to the te st: this will certainly be a stretch of your visualization skills! (This talk is better suited for those with a small background in knot theory, but it should be accessible to a general audience.)

The Venn-Brunnian Connection

Ashleigh M. Stelter
Mount Vernon Nazarene College

Abstract 2: In this paper, we explore the possibility of transforming a 2-dimensional Venn diagram to a 3-dimensional set of knots. The specific sets of knots we explore are Brunnian links, where when any component is removed, the other components fall free. In this paper we show how assigning over and under crossings to a Venn diagram produces a link. The use of matrices as a representation of crossing assignments leads to the discovery of a symmetric pattern. The resultant link is run through a series of tests to see if it is, in fact, Brunnian. We make observations as to the palindromic structure of the resultant links, a pivotal aspect in proving the link is Brunnian. We therefore show that it is possible to formulate an algorithm to transform a Venn diagram of any n rings into a Brunnian link of n components.

From the Slide Rule to the TI-Nspire, We've Come a Long Way!!

Cathy Stoffer
Ashland University

Abstract 3: I've recently started building a library of video demonstrations for students in undergraduate math classes. These short video clips demonstrate the use of a graphing calculator or a computer software package, or repeat classroom computer demonstrations of various topics. The information in the videos is hard for students to take notes on, because it involves action. By making the videos available online, I enable students to review information they may not have caught in class. I'm also able to avoid spending class time discussing technical calculator tasks that most students have already mastered. In this talk, I will demonstrate some features of a few videos, and discuss some of the issues involved in creating these videos.

Modern Cryptology Conundrums: Efficient Factoring Methods for Large Integers

Joanna R. Kreiselman
Denison University

Abstract 4: Factoring various hundred-digit integers is paramount in twenty-first century cryptology. Basic factoring techniques (such as dividing an integer n by each value from 2 to the square root of n) become extremely time-consuming and inefficient as n grows larger. We will examine the Pollard Rho method--a process designed to factor large integers in a matter of seconds. This talk is intended for audiences familiar with modular arithmetic.

Determining Two-Dimensional Laplacian Vector Fields Using Conformal Mappings

Harrison D. Potter
Marietta College

Abstract 5: The utility of conformal mappings in determining two-dimensional Laplacian vector fields is well established. Many problems involving Dirichlet and Von Neumann boundary conditions that arise in the study of heat flow, electrostatics, and fluid flow can be solved using these techniques. Flows produced by point sources and sinks can also be determined using these techniques in combination with the method of images. Here we investigate generalizations of these problems to those involving intervals of source and sink.

Friday 4:45 – 5:00

Interdependencies of Bundle Forms and Degradations of Minkowski Space

Robert D. Knight
Ohio University - Chillicothe

Abstract 6: We explain the connection between the Veblin-Young axiom for projective space and the Full Bundle Theorem for Laguerre planes by looking at the 3-dimensional Minkowski space model of the classical Laguerre plane. The affine version of the Veblin-Young axiom holds in this model, but is false in many non-classical cases. It certainly does not hold when the Full Bundle Theorem fails. The Full Bundle Theorem (actually an axiom) can be split into 26 variants, called bundle forms. Each of these bundle forms can be added to the basic axioms o f a general Laguerre plane. We will present some recent results regarding the interdependence of these bundle forms.

Wizarding Wisdom

Kate Plummer
Ashland University

Abstract 7: In the final scenes of Harry Potter and The Sorcerer's Stone, a problem is brought up involving seven bottles, three with poison, two with wine and two with special potions. Was it a great act of magic that solved the problem, or just simple mathematical logic? In my talk, we will look at the logic problem presented in the book. I will explain the logic used and give other, general examples of such problems.

Cooperative Learning

Philip Blau
Shawnee State University

Abstract 8: The talk will discuss trying to engage students in effective group work that will lead to cooperative learning. In particular, we will look at an attempt in a college algebra course to employ some of the ideas found in a book by Millis and Cottell, especially those of positive interdependence and individual accountability.

Asymptotic Stability of a Class of Second Order Delay Difference Equations

Olwen Conant
Cleveland State University

Abstract 9: Purpose: In this project we study a second order difference equation. It has been observed that the set of solutions to a difference equation may exhibit behavior that varies widely with even small changes in the values of the initial conditions. We examine the behavior of a second order difference equation with positive initial conditions and non-negative parameters and look for asymptotic behavior.

Investigating the Rotations of a Cube

Kendra L. Bruns and Jeraco R. Speelman
University of Findlay

Abstract 10: In this presentation, we discuss the rigid motions of a square. We will then attempt to generalize those results in three dimensions by investigating the rigid motions of a cube. It was discovered that the group of rotations of a cube is isomorphic under composition to the group of rigid motions of a square.

Friday 5:05 – 5:20

J.W.L. Glaisher and Some Identities Involving Euler's Constant

Thomas P. Dence
Ashland University

Abstract 11: The MAA celebrated Euler's 300th birthday last year with some special publications. We will look at some of the identities involving Euler's constant in one of them, along with the man who published them.

Epidemiology on the Farm

Samuel J. Behrend
Denison University

Abstract 12: Don't you just hate it when your entire potato crop just up and dies on you after you'd spent weeks and hundreds of dollars on Jim-Bob's Miracle Spud Solution©? We feel your pain. Last summer, our team analyzed multiple systems of differential equations, each attempting to model a certain aspect of real-world infectious diseases as applied to human and plant populations. We also developed stochastic cellular automaton models of epidemics on a two-dimensional landscape, much like a common plot of farmland. We investigated the impact of various containment strategies, both in terms of minimizing the size of the outbreak and maximizing the crop yield. We hope that further development of our modeling framework will lead to the creation of even more effective disease control measures. This presentation recommends at least a basic understanding linear algebra and calculus.

An overview of Coordinated Precalculus at Cleveland State University

Ieda Rodrigues
Cleveland State University

Abstract 13: The CSU Mathematics Department offers Precalculus as a two semester sequence. In Fall 2007, the first course of the sequence was offered in coordinated form. An web based learning program called ALEKS was also introduced. Currently, the experiment has been extended to the all sections of Precalculus. The talk will be a report on the changes made to the program and its impact on students and faculty. Assessment tools to determine success/failure of the experiment will also be discussed.

Probabilities in the Game of RISK - More Efficiently Calculated

Ryan Knobeloch
Mount Vernon Nazarene College

Abstract 14: In the game of RISK, dice are rolled to determine who wins the battles. Using laws of probability, we can calculate the chance to win a certain battle, given the number of attacking soldiers and the number of defending soldiers. However, such calculations can become needlessly complex and time-consuming, even for very fast computers. Are there ways to simplify the calculations? If so, how much more efficient can these methods be? You may be surprised by how much faster the calculations can be completed.

Rational Approximation of Irrational Numbers

Brian J. Stewart
Cleveland State University

Abstract 15: This talk will discuss Diophantine inequalities and rational approximation of irrational numbers. The discussion presents the density of the real line and Dirichlet's Approximation Theorem as motivation. Infinite continued fractions are introduced as a mathematically elegant apparatus which produces an infinite sequence of better and better rational approximations to any given irrational number. The discussion of Diophantine inequalities progresses to Liouville's Theorem and a class of transcendental numbers called Liouville numbers.

Friday 5:25 – 5:40

Solving Fermat's Equation for n=3

Olusegun M. Otunuga
Marshall University

Abstract 16: Solving Fermat's last equation(that states that there does not exist x,y,z member of integers such that $x^n+y^n=z^n$, for $n>2$ where n is an integer). I will only be solving the case where n = 3 using the characteristic of the solution of a cubic polynomial.

Markov Chains and the Heat Bath Monte Carlo Algorithm for the Ising Model of Ferromagnetism

Christopher M. Lemon
Ohio Northern University

Abstract 17: The theory of Markov Chains is placed in the context of the Ising model of ferromagnetism, an important problem in statistical physics. Although not a Markov chain itself, the two-dimensional Ising model can be simulated with the heat bath algorithm, which treats the Ising model as a Markov Chain. A Matlab program and variations were written that use Monte Carlo simulation and the heat bath algorithm to compute quantities arising in the Ising model. Results from this method were then compared to results derived from the mathematical definition of the Ising Model. Based on the agreement of results, it is concluded that the heat bath Markov Chain method is a convenient and valid method to simulate the two-dimensional Ising model.

Are You Pleased with the Mathematics Requirements for Middle Grades Math Teachers in Ohio ??

Dick Little
Baldwin Wallace College

Abstract 18: As a follow-up to my talk at the fall meeting, I would like to share my disappointment in the present math requirements for math teachers in grades 4 through 9. Please bring 15 to 20 copies of the math requirements for students preparing at your institution to be middle grade math teachers. Let us share our programs and try to come to some consensus of what we would prefer the math

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requirements to be. If you have not yet read The Teaching Gap by Hiebert and Stigler try to obtain a copy or go on line to read a review of it.

Hazard Rate Functions and Their Impact on Annuities

Erika R. Mignogna
Cleveland State University

Abstract 19: An important topic in mathematical finance is the analysis of the cost of annuities. This presentation will discuss the basics of compounding interest, including both constant and variable interest rates. The impact of interest rates on mortgage payment and loan repayment will be examined. Hazard rate functions, which account for the variation in the life span of an annuity, will also play a role in determining the expected value of annuities. In addition, by evaluating a hazard rate function, the corresponding survivor, cumulative distribution, and density distribution functions can be derived and studied. Information concerning both the expected value of annuities and their variation is extremely important to life insurance companies that must assess the risk in selling these annuities as life insurance policies.

Burnside's Theorem

Krista Foster
Youngstown State University

Abstract 20: Burnside's theorem gives a method of counting the number of orbits of a set under the action of a group of symmetries. Let G be a finite group acting on a finite set X. If N is the number of orbits in X under the action of G, then $N = \frac{1}{|G|} \times \sum_{g \in G} |Xg|$. I will discuss this Burnside's theorem as it applies to counting problems.

Friday 5:45 – 6:00

The Structure of Digroups

Andrew Magyar
Ohio Northern University

Abstract 21: In this presentation, we investigate the algebraic structure of digroups. We find a Lagrange-style correspondence between digroups and subdigroups. We also show how to construct a digroup containing any given number of identities whose order is a multiple of that number. Then, all digroups with inverse sets of prime order are classified. Additionally, the terms subdigroup, commutant, trivial digroup, and idempotency class are defined and basic results are proven with respect to each term. Finally, various structural propositions are proven which may be useful in future digroup research.

Using Differential Equations to Model Competition Among Species

Jonathan A. Schilens
Cleveland State University

Abstract 22: We can obtain a lot of information from systems of differential equations. The true beauty of this branch of mathematics comes from its applications. In this presentation, mathematics and biology collide as we explore an application of systems of differential equations to the behavior of two and three competing species. We will look at specific examples of competition models (Lotka-Volterra and May-Leonard Competition Models) and show how they relate to the real world.

Statistics Across the Curriculum: A Partnership Between Mathematics and Business

James A. FitzSimmons and Angela D. Mitchell
Wilmington College

Abstract 23: During the fall semester of 2007, we (Jim FitzSimmons from the mathematics department and Angela Mitchell from the business department) experimented with a cross-departmental statistics partnership. Both of us were teaching a statistics course in our separate departments and decided to have the students from our classes work together on shared statistics projects that culminated in both papers and presentations. This talk will discuss the method that we used as well as both the positive outcomes and the challenges that we and the students found in this collaborative effort.

The Effective Condition Number

Tyler W. Drombosky
Youngstown State University

Abstract 24: The condition number is very useful when determining the accuracy of solutions to linear systems when using computer solvers. However, recent meshless methods for approximating partial differential equations have been know to create ill-conditioned matrices, yet are still able to produce results that are close to machine accuracy. We consider the relationship between the effective condition number and the accuracy of approximations for ill-conditioned linear systems that arise when using the Method of Fundamental Solutions.

How to Ride a Unicycle and Why it IS Rocket Science

John T. Noonan
Mount Vernon Nazarene College

Abstract 25: We will explore some extremely simplified models that describe the act of balancing a unicycle. We also examine some similarities between balancing a unicycle and placing a satellite in low earth orbit.

Friday 6:05 – 6:20

Tarski's Circle-Squaring Problem Dissected

Jeffrey A. Willert
College of Wooster

Abstract 26: Tarski's famous Circle-Squaring Problem asks whether it is possible to decompose a circle into finitely many pieces and rearrange the pieces to form a square of equal area. In 1990, M. Laczkovich shocked mathematicians by providing an affirmative answer to this question. Remarkably, he also shows that the rearrangement requires translations only - no pieces need to be rotated in the construction of the square. His proof, however, is non-constructive, and the pieces are impossible to visualize. In this presentation we explore our method for "approximate circle-squaring" as we illustrate the process for squaring certain inscribed regular polygons.

Sudoku: Math or No Math?

Rachel M. Cordy
Ashland University

Abstract 27: Have you been struck by the Sudoku craze yet? Are those silly puzzles just mindless entertainment or is there mathematics to back up all the fun? In my talk, I will discuss the history and origins of Sudoku, investigate some of the variations of the puzzle and look at determining the number of unique solutions a puzzle could have. This talk intended for a general audience.

Bridging the Gap Between Algebra and Abstract Algebra

Erica D. Keene and Ryan L. McDannell
University of Findlay

Abstract 28: In this presentation, we will discuss the evolution of abstract algebra from the perspective of solving polynomial equations. We will do this by considering the generalized solutions to quadratic, cubic, and quartic equations. We will then demonstrate what elements of abstract algebra were necessary to show there is no general solution for the quintic equation.

A True Baseball Fan: Or One Who Just Likes to Travel

Kevin E. Jackson
Ashland University

Abstract 29: One might already be acquainted with the famous "Traveling Salesperson Problem (TSP)." In this talk, we will take a look at the TSP and see how it is applied to real like situations. If you are a true baseball fan, you might want to see every team in the league play once during the season at their home ballpark. In this talk, I will take a look at how a true fan can do that.

Saturday 10:25 – 10:40

The Extended Lagrange Mean Value Theorem

Christian James
(Mary Hyde, Zengxiang Tong, and Thomas James)
Otterbein College

Abstract 30: In this paper, we will first use an example to show the need for extending the Lagrange Mean Value Theorem. Then we will introduce and explore the properties of the concept of tangentality of a function. Basing on the tangentality, we will establish extended Fermat Theorem, Extended Rolles Mean Value Theorem, and Extended Lagrange Mean Value Theorem.

Continuous Images of the Cantor Set

Judith A. Palagallo
University of Akron

Abstract 31: Every curve in the plane is the continuous image of the middle-thirds Cantor set. Examples in this presentation illustrate that these images can create curious and unusual curves.

Permutation Statistics

Alissa M. Douglas
Capital University

Abstract 32: The number of inversions of a permutation is the number of needed transpositions of adjacent elements required to put the numbers in increasing order. The number of inversions of a permutation is a permutation statistic, which is a function that maps all permutations to a number. We will discuss similar statistics for permutations and the construction of a database to organize them.

Alphametics

Jordan Job
Ashland University

Abstract 33: In this discussion, I will reveal to the audience a mechanism involving the algebraic use of letters to represent numbers. This mechanism can be solved through the wonderful world of algebraic puzzles. This process, known as alphametics, can be used to construct a short distinct message. The audience will see that each letter has a distinct digit and the words constructed are associated with as many digits as there are letters. This presentation is intended for the general audience.

An Introduction to Degree Theory on R^n

Damon F. Haught
Youngstown State University

Abstract 34: The degree of a map f is a useful tool for proving the existence of solutions to f(x)=0. We will introduce the notion of the degree of a continuous function from R^n to R^n and use this to prove the Brouwer Fixed Point Theorem.

Saturday 10:45 – 11:00

Relativity and The Perihelion Precession of Mercury's Orbit

Jessica M. Schwan
Cleveland State University

Abstract 35: According to Johannes Kepler, the orbit of every planet revolving around the sun traces out an elliptical path. The center of the sun, or rather, the common center of gravity between the sun and the planet, will be at one focus of this ellipse. Thus, in the course of one year of the planet, the distance between the sun and the planet grows from a minimum to a maximum, and then shrinks back to a minimum. The point of closest approach, called the perihelion, was classically considered to be a fixed point in the orbit of the planet. In actuality, many different effects from celestial bodies in the solar system cause this perihelion to precess, or rotate around the sun. In particular, non-agreement between measurements of the precession of the perihelion of the planet Mercury and calculations of the precession, was a longstanding problem, unexplained by the basic laws of Newtonian mechanics. This problem was, in effect, solved by Einstein's theory of relativity, which predicted the observed amount of perihelion shift for Mercury within experimental error. One can calculate the differences between Newtonian model for planetary mathematics and the Einsteinian model. This difference, surprisingly, considering the great differences between the two models, is only a small term in a differential equation. With only a small technical addition, but with a vastly different outlook, Einstein solved Mercury's problem, and many others he never even dreamed of.

Geometric Properties of Generalized Fractal Curves

David M. Freeman
University of Cincinnati

Abstract 36: What is a fractal curve? Most definitions involve the notion of self similarity. That is, the appearance of the curve is not affected by the location or scale at which it is viewed. A natural generalization of self similarity is that of bilischitz homogeneity. Bilipschitz homogeneous (BLH) curves have the same appearance at each location but their appearance may change with scale. Such curves possess many useful properties. For example, a BLH curve must form the boundary of a quasidisk. In other words, the curve cannot contain excessively sharp corners or disproportioned folds. This presentation will focus on new results about related geometric properties of BLH curves.

Binomial Coefficients from a Polynomial: Hidden Patterns in Pascal's Triangle

Brian J. Ervin
Wittenberg University

Abstract 37: In my Freshman Fractals class, we discussed Pascal's triangle. I was intrigued by the patterns we studied. This led me to search for other, more subtle patterns. In my talk, I will show some of the less obvious patterns I found along with a related polynomial that generates these patterns. I will explain how I discovered these patterns, prove that the polynomial is valid in all cases, and present some additional, interesting relationships I have come across during my investigation.

Musical Mathematics

Kimberly A. Alley
Ashland University

Abstract 38: When most people hear the two words mathematics and music, generally they don't associate the two together. In my talk, I will give a brief overview of the connection of these two subjects. The relationship between music and mathematics can be dated back to the 6th century B.C. Since then it has been discovered that music and math are related through the Pythagorean Circle, Euclid's algorithm, and also music has been found to relate to the Fibonacci numbers. This presentation will show how mathematics have influenced the musical world to this day. This talk is intended for a general audience.

The Pigeonhole Principle and Ramsey's Theorem

Kai L. Ng
Cleveland State University

Abstract 39: "If n > m pigeons are put into m pigeonholes, there is a hole with more than one pigeon." The Pigeonhole Principle sounds so obvious and intuitive that it is considered trivial by some people. However, this subtle principle, when invoked in mathematical arguments, can produce powerful and not-so-intuitive results. This is evident in the proofs of some combinatorial existence theorems. In this presentation, we will consider the proof of Ramsey's Theorem in which the principle plays an instrumental part.

Saturday 11:05 – 11:20

Optimizing Quadratic Forms of the Unit Sphere

David R. Martin
Youngstown State University

Abstract 40: When the universe of discourse is (or can be transformed into) the set of unit vectors, an elegant manner of determining the extreme values of a quadratic form involves analysis of the associate matrix. In general, this works great for problems of arbitrary dimension.

A Study of the Dice Game 10,000

Thomas F. Majercik, Jr.
Cleveland State University

Abstract 41: 10,000 is a household dice game that has different "house rules" depending on whoever's house you happen to be playing in at the time. I will look at the most common set of rules, one where no special rolls (straights, three pairs, etc., although they will be mentioned) are counted in scoring and I will examine the distribution of all scoring rolls dependent on the number of dice that are rolled. Then using these distributions, I will use dynamic programming to determine the best strategy to play (and win) the game from several different strategies that I have come up with.

Rational Numbers Associated with Arithmetic Functions Evaluated at Factorials

Daniel M. Baczkowski
University of South Carolina

Abstract 42: Florian Luca established that for a fixed rational number r, there are a finite number of positive integers n and m for which f(n!) = r * m! where f is one of arithmetic functions: the number of divisors function, Euler's phi function, or the sum of the divisors function. In this joint work with Filaseta, Luca, and Trifonov, we establish a generalization of these results, in particular a consequence of our work is the following: Let k be a fixed positive integer. Then

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there are finitely many positive integers n, m, a and b such that b * f(n!) = a * m!, gcd(a,b) = 1, and the number of distinct prime divisors of ab is < k.

The Abundancy Spiral

Judy A. Holdener
Kenyon College

Abstract 43: In 1963, Stanislaw Ulam discovered a curious pattern relating to the distribution of the primes within the integers. This pattern, now known as "Ulam's spiral," appeared on the cover of Scientific American in March of 1964, and it continues to attract attention today. In my talk I will present the related "Abundancy Spiral," which I create by assigning a color to each positive integer n based on the value of the abundancy index, I(n), of the integer. (The abundancy index of n is defined to be the ratio I(n) = ?(n)/n, where ?(n) is the sum of divisors of n.)

Modeling Associative Memory with Hopfield Neural Networks

Boris Kerkez
Ashland University

Abstract 44: One of the most important issues in Artificial Intelligence is modeling of human memory, including storage, indexing, and retrieval of learned concepts. A recurrent artificial neural network called the Hopfield Network utilizes mathematical models in order to mimic the functionality of the associative memory in humans. Hopfield networks have been applied to a wide variety of complex problems that are too difficult to solve using standard techniques, including the Traveling Salesman and the Optical Character Recognition problems. We will take a look at the theory behind the Hopfield Network and see examples of its application.

Saturday 11:25 – 11:40

Fundamental Solution of Dirac System

Wen Liu
Kent State University - Stark

Abstract 45: We construct the fundamental system of solutions of time dependent Dirac system by using the Euler's method. Using the fundamental system of solutions we describe the conservation law for Dirac system. We also establish the error estimates for representation of solutions via approximate fundamental system. Using this representation of solutions, we find out approximate conservation laws as well.

Markov Transition Matrices

Moriah E. Wright
Youngstown State University

Abstract 46: Markov chains are used to represent evolving processes between a number of possible states of the processes. Matrices that describe the states are called transition matrices. Applications of these matrices used to model population migration in the Youngstown area will be considered.

Birkhoff's Theorem on Doubly Stochastic Matrices

M.B. Rao
University of Cincinnati

Abstract 47: Markov chains are used to represent evolving processes between a number of possible states of the processes. Matrices that describe the states are called transition matrices. Applications of these matrices used to model population migration in the Youngstown area will be considered.

NOTES

Acknowledgements

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Coming Events!

The Ohio Section Summer Short Course, **"Study The Masters: Using Primary, Historical Sources In Teaching And Research"** will be held **June 18-20, 2008** at **Xavier University**, in Cincinnati, Ohio. **David Pengelley** of New Mexico State and **Danny Otero** of Xavier will be co-presenters.

Mathfest 2008 will be held in Madison, Wisconsin, **July 31 – August 2**

The **Fall Meeting** of the Ohio Section will be **October 24-25, 2008** at **Capital University** in Columbus, Ohio.