Program of Activities

For the 2016 Fall Meeting of the

Mathematical Association of America

Ohio Section

Fall, 2016

The College of Wooster

Wooster, Ohio

October 28-October 29, 2016

MAA Ohio Section

Fall 2016 Program

Friday, October 28

12:00-4:00	Registration	Freedlander Lobby
12:00-1:00	Committee Meetings:	
	CONCUR (Curriculum)	Taylor 205
	CONSACT (Section Activities)	Taylor 206
	CONTEAL (Teacher Education & Licensure)	Taylor 209
1:00-4:00	Vendor & Book Exhibits	Freedlander Lobby
1:15-1:30	Welcome and Announcements	McGaw Chapel
1:30-2:30	Panel Discussion: **"State of Online Teaching of College Level Mathematics in Ohio"** Jim Fowler, Karen Mitchell, Laura Stapleton, and Richard Uchida.	McGaw Chapel
2:30-2:50	Break	Freedlander Lobby
2:50-3:50	Invited Address by winner of the Distinguished Teaching Award: **"A Study of Dynamic Equations Using Mechanical Integration"** Bonita Lawrence aided by Clayton Brooks and students Chad Lott and Paige Yankey.	Lean Lecture Hall
4:00-5:40	Executive Committee Meeting	Taylor 308
5:00-6:15	Contributed Paper Sessions (4 time slots)	Taylor 110, 111, 205
6:15-6:50	Social Time	Kittredge Hall
6:50-8:00	Banquet	Kittredge Hall
8:00-9:00	Invited Address: **"Assignment Problem, Cheater's Rubik's Cube, and Tropical Determinant"** Jenya Soprunova	Kittredge Hall

Saturday, October 29

8:00-10:00	Registration	Freedlander Lobby
8:00-10:00	Book Vendors and Exhibits	Freedlander Lobby
8:00-9:25	Coffee and Pastries	Freedlander Lobby
8:50-9:25	Committee On Local Arrangements and Executive Committee Meeting (if needed)	Taylor 308
9:25-9:35	Welcome and Announcements	Lean Lecture Hall
9:35-10:35	Invited Address: **"Intrinsic Properties of Graphs in R^3"** Erica Flapan	Lean Lecture Hall
10:35-10:50	Break	Freedlander Lobby
10:50-11:45	Contributed Paper Session (3 time slots)	Taylor 110, 111, 205
11:45-12:00	Break	
12:00-1:00	Invited Address: **"Deblurring Images with Mathematical Models"** Malena Espanol	Lean Lecture Hall
1:00-1:10	Closing Remarks	Lean Lecture Hall

Abstracts of Invited Addresses

Friday

Speaker: Bonita Lawrence aided by Clayton Brooks and students Chad Lott and Paige Yankey, all of Marshall University

Title: *A Study of Dynamic Equations Using Mechanical Integration*

Abstract: The Marshall Differential Analyzer Lab offers undergraduate and graduate students the opportunity to investigate both the quantitative and qualitative behavior of solutions of certain classes of differential equations using primarily mechanical differential analyzers. After a bit of training to use the machines, students have the freedom to plan their research study, program the machine, run the problem and analyze the results. Recently, the team has been studying the behavior of solutions on sets known as time scales. In particular, the group has been studying time scales that are unions of closed intervals. The goal is to study the behavior of solutions as the sets converge to a single closed interval. A discussion of the relationship between the mechanics of the machine and the mathematics that it models will be presented as well as a demonstration by my graduate students of how we run a problem on one of the small traveling machines known as DA Vinci!

Speaker: Jenya Soprunova, Kent State University

Title: *Assignment Problem, Cheater's Rubik's Cube, and Tropical Determinant*

Abstract: Consider n workers and n jobs, where we know how much each worker charges for each job. The classical assignment problem deals with assigning the jobs, one for each worker, so that the overall cost is as small as possible. We will discuss a polynomial-time algorithm for solving this problem that was developed by Harold Kuhn in 1955.

Next, consider the usual Rubik's cube with 9 square stickers on each side colored in one of six colors. We want to solve Rubik's cube by peeling off the stickers and replacing them so that each of the faces has all stickers of one color. We will figure out how many stickers we would need to peel off and replace in the worst case scenario and will also discuss a few generalizations of this problem.

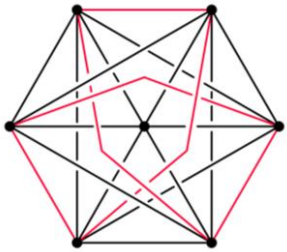
We will explain a connection between these two seemingly very different problems and will also talk about tropical determinants, linear programming, Hall's marriage theorem, and the Birkhoff polytope.

Saturday

Speaker: Erica Flapan, Pomona College

Title: *Intrinsic Properties of Graphs in* $\mathbb{R}^3$

Abstract: Knot theory is the study of embeddings of simple closed curves in $\mathbb{R}^3$. A natural extension of knot theory is the study of embeddings of graphs in $\mathbb{R}^3$. However, in contrast with knots, the structure of a graph can be complex, and this can affect all of its embeddings. If every embedding of a graph has a particular property, then we say that property is *intrinsic* to the graph. For example, a graph is said to be *intrinsically knotted* if every embedding of the graph in $\mathbb{R}^3$ contains a knot. In this talk, I will discuss intrinsic knotting and other intrinsic properties of graphs.



Speaker: Malena Espanol, The University of Akron

Title: *Deblurring Images with Mathematical Models*

Abstract: When we use a camera, we want the recorded image to be an accurate representation of the scene that we see. However, in some situations such as photographing a moving object, what we obtain can be a blurred image. In image deblurring, we seek to recover the original, sharp image by using a mathematical model of the blurring process. In this lecture, we will see a brief introduction to the basic image deblurring problem and some mathematical tools to address it.

Brief Biographies of Invited Speakers

Bonita A. Lawrence, Marshall University

Inspired by her high school mathematics teacher, Mary Helen Miller, **Dr. Bonita Lawrence** began her formal mathematics training at Cameron University in Lawton, Oklahoma. After a short career as a classroom teacher, she returned to the university to continue her education, earning a Master's degree at Auburn University and a Ph. D. at the University of Texas at Arlington. Her Ph. D. dissertation was written in the area of Stochastic Differential Equations.

Intrigued by studies of the similarities and differences between the differential and difference equations, her research studies now focus on results in the area of Dynamic Equations on Time Scales. Dr. Lawrence is a Professor of Mathematics at Marshall University and is the Lead Researcher for the Marshall University Differential Analyzer Lab. Her lab houses the only publicly accessible differential analyzer of its size in the USA (and beyond). She is the recipient of several College and University teaching and research awards and was named the 2009 – 2010 West Virginia Professor of the Year. Dr. Lawrence is married to Dr. Clayton Brooks, also a Professor of Mathematics at Marshall University.

Jenya Soprunova, Kent State University

Jenya Soprunova is an Associate Professor of Mathematics at Kent State University. She received her Ph.D. from the University of Toronto in 2002.

Jenya has worked as coordinator and advisor for the NSF funded REU program at Kent State.

She coordinates the Choose Ohio First: Success in Math program and a Masters' program for secondary mathematics teachers at Kent State. Her research interests include combinatorial and computational algebraic geometry, discrete geometry, and algebraic coding theory.

Erica Flapan, Pomona College

Erica Flapan joined the faculty at Pomona College in 1986. Since 2006, she has been the Lingurn H. Burkhead Professor of Mathematics at Pomona College. In addition to teaching at Pomona College, Flapan taught at the Summer Mathematics Program for freshmen and sophomore Women at Carleton College from 2000 until 2015. In 2011, Flapan won the Mathematical Association of America's Haimo award for distinguished college or university teaching of mathematics. Then in 2012, she was selected as an inaugural fellow of the American Mathematical Society. She is currently a Polya Lecturer for the MAA.

Erica Flapan has published extensively in topology and its applications to chemistry and molecular biology. In addition to her research papers, she has published an article in the College Mathematics Journal entitled "How to be a good teacher is an undecidable problem," as well as four books. Her first book, entitled ``When Topology Meets Chemistry" was published jointly by the Mathematical Association of America and Cambridge University Press. Her second book entitled ``Applications of Knot Theory," is a collection of articles that Flapan co-edited with Professor Dorothy Buck of Imperial College London. Flapan also co-authored a textbook entitled ``Number Theory: A Lively Introduction with Proofs, Applications, and Stories" with James Pommersheim and Tim Marks, published by John Wiley and Sons. Finally, the AMS recently published her book entitled "Knots, Molecules, and the Universe: An Introduction to Topology", which is intended for first and second year college students.

Malena Espanol, The University of Akron

Malena Espanol is an Assistant Professor of Applied Mathematics at The University of Akron. Originally from Argentina, she received her B.S. from the University of Buenos Aires in 2003 and her Ph.D. from Tufts University in 2009. After graduation, she spent 3 years as a postdoctoral fellow at the California Institute of Technology. Malena is a national Project NExT Fellow (Brown'13 dot) and has participated in several Ohio NExT workshops. She serves as the faculty advisor for both UAkron SIAM student Chapter and the Women in Math group. She is also a member of the SIAM Diversity Advisory Committee.

Malena's research interests are in applied and computational mathematics with applications to image processing and materials science. Malena has been the recipient of several grants that include an MAA-Tensor Women and Mathematics and two NSF grants.

Contributed Paper Sessions

*denotes undergraduate student
**denotes graduate student

Friday, October 28
5:00—6:15

Time	**Session A** Taylor 110 Session Chair: Keshav Pokhrel	**Session B** Taylor 111 Session Chair: Russell W. Kincaid
5:00 – 5:15	***What Can We Do to Help?*** Abstract 1 Karen Mitchell Marshall University	***Disparities in Childhood Mortality Rates in the Great Lakes Region*** Abstract 2 Broderick Wagerson * The University of Michigan
5:20 – 5:35	***Teaching Statistics with Rmarkdown*** Abstract 4 Keshav Pokhrel The University of Michigan-Dearborn	***Changing the Odds: Loaded Dice in a Probability Classroom*** Abstract 5 Russell W. Kincaid Wilmington College
5:40 – 5:55	***The Gompertz Dynamic Equation*** Abstract 7 Tom Cuchta Fairmont State University	***Brain and Intelligence: Why Humans Are So Dominant Part I*** Abstract 8 M. B. Rao The University of Cincinnati
6:00 – 6:15	***The Precession in the Perihelion of the Orbit of Mercury*** Abstract 10 Harrison D. Potter Marietta College	***Brain and Intelligence: Why Humans Are So Dominant Part II*** Abstract 11 M. B. Rao The University of Cincinnati

Contributed Paper Sessions

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**denotes graduate student

Friday, October 28
5:00—6:15

Time	**Session C** Taylor 205 Session Chair: Kevin Gerstle
5:00 – 5:15	***An Inequality for Motions with a Positive Jerk*** Abstract 3 Aurel Stan The Ohio State University - Marion
5:20 – 5:35	***Baire's Lessons on Discontinuous Functions*** Abstract 6 Philip S. Blau Shawnee State University
5:40 – 5:55	***Sequences Converging to n^{th} Roots*** Abstract 9 Adam E. Parker Wittenberg University
6:00 – 6:15	***The Beta Transmuted Pareto Distribution: Theory and Applications*** Abstract 12 Sher B. Chhetri ** Florida Atlantic University

Contributed Paper Sessions

*denotes undergraduate student
**denotes graduate student

Saturday, October 29
10:50—11:45

Time	**Session A** Taylor 110 Session Chair: Pei Pei	**Session B** Taylor 111 Session Chair: Susan Thompson
10:50–11:05	***Transient Distribution of a 2 Dimensional Random Walk*** Abstract 13 Barbara Margolius Cleveland State University	***A Shidoku Exercise for Abstract Algebra*** Abstract 14 Taylor Haydinger* Defiance College
11:10–11:25	***The Induced-Saturation Number of Cycles*** Abstract 16 Cathy Erbes Hiram College	***Hamiltonian Dynamics: A Geometric Approach to Classical and Quantum Mechanics*** Abstract 17 Barbara A. Sanborn Antioch College
11:30–11:45	***Category of Bijective Mappings over the Finite Field of Size 8*** Abstract 19 Zhijun Yin The University of Akron	***Enumeration of Violating Configurations to the Sonar Sequence Property in 0-1 Matrices*** Abstract 20 Christopher N. Swanson Ashland University

Contributed Paper Sessions

*denotes undergraduate student
**denotes graduate student

Saturday, October 29
10:50—11:45

Time	**Session C** Taylor 205 Session Chair: Alfred Akinsete
10:50–11:05	***Polygonal Numbers that Are neither a Sum nor a Difference of Two Prime Powers*** Abstract 15 Dan Baczkowski The University of Findlay
11:10–11:25	***Decimals, Fractions, and Cycling Digits*** Abstract 18 Patricia L. Johnson Ohio Northern University
11:30–11:45	***The Solution to the Two-Envelope Paradox*** Abstract 21 Ed Meyer Baldwin Wallace University

Abstracts of Contributed Papers

Friday 5:00-5:15

What Can We Do to Help?

Karen Mitchell
Marshall University

Abstract 1: The shortage of secondary math teachers is so extreme that many states, including those in the Appalachian region, have been forced to take extraordinary measures. How can college or university mathematics faculty help address this shortage? This presentation will detail an alternate certification project designed to help individuals acquire a knowledge base that will better prepare them to teach high school mathematics.

Disparities in Childhood Mortality Rates in the Great Lakes Region

Broderick Wagerson
The University of Michigan

Abstract 2: Childhood cancer rates have been rising continuously since 1990. Using data from the Surveillance, Epidemiology and End Results database we model and analyze variations in mortality and incidence rates throughout the United States for the ages 0-19 and the five most prevalent cancers. This work shows there are key differences among trends for mortality and incidence rates among between age groups and cancer types throughout the Great Lakes states and the whole U.S.

An Inequality for Motions with a Positive Jerk

Aurel Stan
The Ohio State University - Marion

Abstract 3: The Hermite-Hadamard inequality says that if an object moves along a straight line with a positive jerk, then the average velocity of the object over every finite time interval is greater than the velocity at the midpoint of that interval, and less than the average of the velocities at the two endpoints of the interval. We first present a visual proof of this inequality, and then use the inequality to reprove some sharp inequalities between the logarithmic mean and some Holder means of two positive numbers.

Friday 5:20-5:35

Teaching Statistics with Rmarkdown

Keshav Pokhrel
The University of Michigan-Dearborn

Abstract 4: Use of technology in the classroom setting is not a new phenomenon these days. Teaching statistics is getting challenging and interesting at the same time as the power of computing is increasing almost every moment. We will discuss about the dynamic documentation of computational outputs from a statistical software R using Rmarkdown. This package will help students to see the statistical model and the effects of change in a parameter instantaneously. In addition, we can compile R-code, Latex commands and pictures in the same document without any hassles from importing and exporting the pictures. This could be a great way to do homework, projects and share work with collaborators.

Changing the Odds: Loaded Dice in a Probability Classroom

Russell W. Kincaid
Wilmington College

Abstract 5: Conventional dice were altered by the insertion of weights for the purpose of creating dice that do not behave according to the conventional rules of probability. The performance of these dice was then characterized by students in the classroom through several hundred experimental trials. These results were then compared against theoretical calculations for one die rolls, two dice roll sums, and three dice roll sums for conventional dice.

Baire's Lessons on Discontinuous Functions

Philip S. Blau
Shawnee State University

Abstract 6: Rene Baire's 1905 book on discontinuous functions gives necessary and sufficient conditions for a function to be the limit of a sequence of continuous functions. Baire first solves the problem for functions of a single real variable and then for functions of n real variables. Fundamental notions such as perfect sets, transfinite numbers, derived sets, and dense sets are treated in the book, which shows the influence of Cantor's work. Biographical facts will be given.

Friday 5:40-5:55

The Gompertz Dynamic Equation

Tom Cuchta
Fairmont State University

Abstract 7: The Gompertz (1st order, nonlinear) differential equation describes a growth curve that is qualitatively different than that of logistic growth: notably that its growth is not symmetric with respect to its inflection point. Dynamic equations are an umbrella term that encompasses differential equations, difference equations, q-difference equations, and many others. We will provide a short overview of first order dynamic equations and investigate a dynamic equation analogue of the Gompertz differential equation.

Brain and Intelligence: Why Humans Are So Dominant Part I

M. B. Rao
The University of Cincinnati

Abstract 8: What is intelligence? Can it be measured across species? What is measurable across species? Some of these issues will be discussed. A data set which provides body and brain weights for a number of animals will be presented and analyzed. Some issues that arise in the analysis will be discussed.

Sequences Converging to n^{th} Roots

Adam E. Parker
Wittenberg University

Abstract 9: Daniel Vargas, and 8th grader from Texas, shared with me a sequence that appears to converge to the nth root of k. For n=2, this algorithm is well known from the theory of Pell's equations. However, I had not seen this algorithm for general nth roots, nor have I been able to find it cited anywhere. In this talk I'll describe the sequence and discuss progress towards proving the result, but I'm very interested if any audience members had seen this algorithm before.

Friday 6:00-6:15

The Precession in the Perihelion of the Orbit of Mercury

Harrison D. Potter
Marietta College

Abstract 10: The shift in the orbit of Mercury is a famous confirmation of Einstein's theory of general relativity. This presentation will show how a differential equation that describes the orbit of Mercury, which is simple enough to serve as a classroom example, can be obtained from vector calculus and the Schwarzschild metric. A straightforward application of the Poincare-Lindstedt method, in combination with an appropriate scaling and data from the NASA website, then yields the famous result.

Brain and Intelligence: Why Humans Are So Dominant Part II

M. B. Rao
The University of Cincinnati

Abstract 11: Some remedial steps will be undertaken to resolve issues that arose in data analysis undertaken in Talk 1. An interpretation of the analysis will be presented to explain our dominance. Other data sets will be outlined that could throw light on our dominance.

The Beta Transmuted Pareto Distribution: Theory and Applications

Sher B. Chhetri
Florida Atlantic University

Abstract 12: In this work, a new five-parameter beta-transmuted Pareto distribution is introduced and studied. Some important properties of the distribution are discussed and explicit formulas are derived for the mean, mean deviation, entropy, order-statistics and the reliability analysis. The method of maximum likelihood is proposed to estimate the parameters of the distribution. We illustrate the usefulness of the proposed distribution by presenting its application to real-life data.

Saturday 10:50-11:05

Transient Distribution of a 2 Dimensional Random Walk

Barbara Margolius
Cleveland State University

Abstract 13: In this talk, we consider two dimensional random walks that are defined in terms of a phase and a level. There are a finite number of phases and an infinite number of levels in the state space for the walk. We show connections between these random walks and the traditional one dimensional random walk using generating functions. The generating function for a one dimensional random walk can be expressed as the product of two Poisson generating functions. The one dimensional random walk generating function appears as part of the formula for many two dimensional random walks.

A Shidoku Exercise for Abstract Algebra

Taylor Haydinger
Defiance College

Abstract 14: The Modern Abstract Algebra class at Defiance College has been participating in a math circle type of exercise this semester. It involves a simplified variation of Sudoku. I will be sharing what we have discovered, some of our experiences along the way, and how it can apply to algebra topics.

Polygonal Numbers that Are neither a Sum nor a Difference of Two Prime Powers

Dan Baczkowski
The University of Findlay

Abstract 15: In 1742, the infamous Goldbach conjecture states that every even integer > 3 can be written as the sum of two primes (and hence can be written as the sum of two prime powers). In 1950, Erdos discovered integers not of the form 2^k + p with k a positive integer and p a prime to answer a conjecture dating back to 1849 of de Polignac. In recent work with an undergraduate collaborator, Justin Eitner, we were able to prove there exists infinitely many triangular numbers that cannot be written as the sum of two prime powers. Moreover, we were able to prove the same holds, not only for the triangular numbers, but also for infinitely many different polygonal number sequences.

Saturday 11:10-11:25

The Induced-Saturation Number of Cycles

Cathy Erbes
Hiram College

Abstract 16: A graph G is H-saturated if it does not contain H as a subgraph, but when any edge is added to G, H does appear as a subgraph. The saturation number of H is the minimum number of edges in an H-saturated graph. In 2012, Martin and Smith generalized this to consider induced copies of H. In this talk, we will present some results about the induced-saturation number of odd cycles and C_4, the cycle on four vertices.

Hamiltonian Dynamics: A Geometric Approach to Classical and Quantum Mechanics

Barbara A. Sanborn
Antioch College

Abstract 17: This talk explains the fundamentals of Hamiltonian systems and shows how the concept of a symplectic structure is useful for understanding both classical and quantum dynamics. The theory of geometric quantum mechanics describes a quantum system as a Hamiltonian dynamical system with a complex projective Hilbert space as its phase space, equipped with an extra Riemannian metric structure not found in classical mechanics. This additional structure makes an appearance in the quantum uncertainty principle.

Decimals, Fractions, and Cycling Digits

Patricia L. Johnson
Ohio Northern University

Abstract 18: When expressed as decimals, many fractions have interesting repetends, and many of these repetends form cyclic permutations of their digits. Using congruence modulo ten and theorems of Fermat and Euler, one can predict the period of repeating decimals and classify many fractions into cyclic "families." This was part of a topics course for middle-school math education majors and so is accessible to all with knowledge of elementary number theory.

Saturday 11:30-11:45

Category of Bijective Mappings over the Finite Field of Size 8

Zhijun Yin
The University of Akron

Abstract 19: Nonlinear bijective mappings play an important role in both system design and attack in the multivariate polynomial public key cryptography. We will introduce the basic result over the GF(8) in our research.

Enumeration of Violating Configurations to the Sonar Sequence Property in 0-1 Matrices

Christopher N. Swanson
Ashland University

Abstract 20: An n x m sonar sequence is an n x m 0-1 matrix with exactly one 1 in each column such that all vectors between pairs of ones are distinct. Given a 0-1 matrix with exactly one 1 in each column, it fails to be a sonar sequence if and only if it contains 1's that form a (possibly degenerate) parallelogram. I will derive a formula for the number of such distinct parallelograms.

The Solution to the Two-Envelope Paradox

Ed Meyer
Baldwin Wallace University

Abstract 21: The Two-Envelope Paradox is a problem that impacts many fields; finance, mathematics, philosophy, economics and specifically risk management. Basically, if there are two envelopes with one that has twice as much money as the other, if we define the amount in one envelope as x then the other envelope has an average of 1.25x. To see this, let's assume that you opened one envelope and it contained $20. Clearly, you should buy the other envelope for $20, it has an average of $25. How can one envelope be better than the other? In my presentation I will reveal the solution to the paradox.

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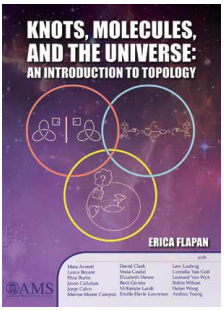

Knots, Molecules, and the Universe

An Introduction to Topology

Erica Flapan, *Pomona College, Claremont, CA*

2016
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This book is an elementary introduction to geometric topology and its applications to chemistry, molecular biology, and cosmology. It does not assume any mathematical or scientific background, sophistication, or even motivation to study mathematics. It is meant to be fun and engaging while drawing students in to learn about fundamental topological and geometric ideas. Though the book can be read and enjoyed by nonmathematicians, college students, or even eager high school students, it is intended to be used as an undergraduate textbook.

The book is divided into three parts corresponding to the three areas referred to in the title. Part 1 develops techniques that enable two- and three-dimensional creatures to visualize possible shapes for their universe and to use topological and geometric properties to distinguish one such space from another. Part 2 is an introduction to knot theory with an emphasis on invariants. Part 3 presents applications of topology and geometry to molecular symmetries, DNA, and proteins. Each chapter ends with exercises that allow for better understanding of the material.

The style of the book is informal and lively. Though all of the definitions and theorems are explicitly stated, they are given in an intuitive rather than a rigorous form, with several hundreds of figures illustrating the exposition. This allows students to develop intuition about topology and geometry without getting bogged down in technical details.

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