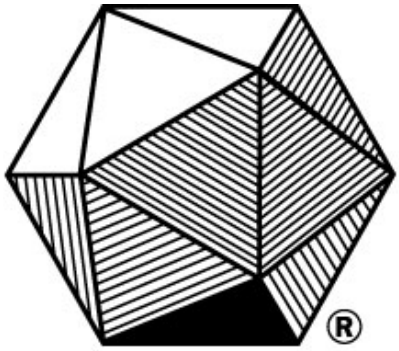

MAA

MATHEMATICAL ASSOCIATION OF AMERICA

77^{th} Annual Meeting of the Oklahoma-Arkansas Section

The University of Tulsa
9–11 April 2015

Celebrating a Century of Advancing Mathematics 1915–2015

OK-AR Section website
http://sections.maa.org/okar/

Executive Committee
2014–2015

Dale Alspach, Past Chair	Anita Walker '17, Secretary
Ron Smith, Chair	Kristi Karber '16, Treasurer
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John Watson, 2nd Vice-Chair	Lisa Mantini, July '14–June '17, Governor

Participating OK-AR Institutions and Abbreviations

ASMSA	Arkansas School for Mathematics, Sciences, and the Arts
ASU	Arkansas State University
ATU	Arkansas Tech University
CU	Cameron University
ECU	East Central University
HC	Hendrix College
HSU	Henderson State University
HU	Harding University
NSU	Northeastern State University
OBU	Oklahoma Baptist University
ORU	Oral Roberts University
OSU	Oklahoma State University
OU	University of Oklahoma
OWU	Oklahoma Wesleyan University
RCC	Redlands Community College
SNU	Southern Nazarene University
SWOSU	Southwestern Oklahoma State University
TU	University of Tulsa
UA	University of Arkansas at Fayetteville
UAFS	University of Arkansas at Fort Smith
UAM	University of Arkansas at Monticello
UCA	University of Central Arkansas
UCO	University of Central Oklahoma

Thursday, 9 April 2015

15:00-19:00 **SECTION NExT**, **Rayzor Hall, CS Conference Room**

18:00-20:00 **REGISTRATION**, **Keplinger Hall, Lower Lobby**

19:00-24:00 **TEAM JEOPARDY COMPETITION**, **Keplinger Hall, Room M1 and Room M8**

Friday, 10 April 2015

7:30-11:30 **SECTION NExT**, **Rayzor Hall, CS Conference Room**

8:00-12:00 **REGISTRATION**, **Keplinger Hall, Lower Lobby**

8:00-12:00 **BOOK SALES, EXHIBITORS, REFRESHMENTS**, **Keplinger Hall, Room U376**

8:30-11:00 **STUDENT WORKSHOP**, **Tyrell Hall, Auditorium**

Mathematics and Sports
Fred Worth (HSU)

Abstract Mathematics and sports interact in many ways. Mathematics allows us to use physics to understand what is happening in sporting events. It allows us to use statistics to document what HAS happened, describe what IS happening, and predict what WILL BE happening. We can also use those statistics to compare athletes over different eras of their sport to support arguments over who is the best (or worst) in their sport. In this workshop we will look at various examples of each of these applications of mathematical ideas.

Bio Dr. Fred Worth, Professor of Mathematics, has been teaching at Henderson State University for 24 years. He has been a sports fan, primarily baseball, for 50 years. Worth has been a member of the Society for American Baseball Research for over a decade, publishing a couple of statistical papers in SABR's *Baseball Research Journal*. McFarland Publishing will soon be publishing his book *College Mathematics through Sports*, a text for mathematics for liberal arts courses using sports as the motivation for all topics. Additionally, Worth is an active participant in biographical research in baseball, particularly in burial sites. He has been to more than 4000 graves of players, managers, etc. A lifelong New York Mets fans, he hates the New York Yankees.

8:30-11:00 **FACULTY WORKSHOP**, **Keplinger Hall, Room L1**

CLEAR Calculus: Coherent Labs to Enhance Accessible and Rigorous Calculus
Mike Oehrtman (OSU) and Jason Martin (UCA)

Abstract This workshop will introduce a sequence of labs for introductory Calculus courses that develop the central ideas of limit, derivative, definite integral, sequences, series, and Taylor series from a unified conceptual perspective. The labs have been developed, refined, and disseminated through Project CLEAR Calculus, a research-based effort to make calculus conceptually accessible to more students while simultaneously increasing the coherence, rigor, and applicability of the content learned in the courses. Evaluation of our implementation with pilot instructors at six universities shows stronger conceptual gains among students than averages from our baseline data set.

In the workshop we will briefly outline the research foundations of the project and move quickly into engaging participants in an example lab to illustrate the flow of student activity and development of understanding and reasoning. We will then distribute several sample labs and discuss the overall conceptual development throughout one or more semesters of calculus. All of the labs and supporting instructor resources are freely available on the project website located at http://clearcalculus.okstate.edu .

Bio Michael Oehrtman is Associate Professor at Oklahoma State University and Jason Martin is Assistant Professor at University of Central Arkansas. Together they received a grant from the National Science Foundation to develop a series of lab assignments that are used throughout the calculus sequence. They look forward to seeing if the faculty attendees can perform as well as the students who have been and are being instructed through the Project!

11:30-12:45 **SECTION NExT LUNCH**, **Rayzor Hall, 2nd Floor, Graves Family Student Commons**

11:30-12:45 **DEPARTMENT CHAIRS LUNCH**, **Rayzor Hall, 2nd Floor, Bellovich Commons**

11:30-12:45 **FACULTY SPONSORS LUNCH**, **Rayzor Hall, 2nd Floor, Graves Family Student Commons**

UNDERGRADUATE TALKS, Keplinger Hall, Room M2 Presiding: Nicholas Jacob (ECU)

13:00-13:15 **The n^{th} Difference of the n^{th} Power**, Caleb Lutz (ORU)

Mentor Andrew Lang

Abstract An exploration of a pattern found by studying alternative ways of deriving power series. The pattern discovered was non-trivial and needed techniques associated with difference triangles to prove. This talk introduces the pattern along with its proof.

13:20-13:35 **Longitudinal Study of Mortality Rates in Lung and Bronchus Cancer Between African Americans/Blacks and Whites in the U.S.A.**, Akinola Akinlawon (CU)

Mentor Jean-Jacques Kengwoung-Keumo

Abstract The aim of the work was to model and analyze the dynamics of lung and bronchus cancer mortality rates for Whites and African Americans/Blacks living in 38 U.S. states and the District of Columbia from 1999 through 2010. Our data set was obtained from the United States Cancer Statistics section of the Centers for Disease Control and Prevention, and the U.S. Census Bureau. A longitudinal linear mixed-effects model was used to study the lung and bronchus cancer mortality rates, and SAS and Mathematica were utilized to perform the computations. Racial disparities still exist in spite of the fluctuating trends in lung and bronchus cancer mortality rates. Whites continue to have higher mortality rates in lung and bronchus cancer than African Americans/Blacks in all 38 states under investigation. This ranking is reversed in the District of Columbia.

13:40-13:55 **Nonregular Robust Parameter Designs and Applications to Engineering and Quality Improvement Processes**, Belina Santos (ASU)

Mentor Debra Ingram

Abstract Robust parameter design (RPD) is a statistical experimental strategy for quality improvement. RPD allows engineers to optimize the settings in a manufacturing process so the effects of uncontrollable variables, called *noise variables*, are minimized. Using these settings during the manufacturing process will make the process robust to uncontrollable variability in the noise variables. RPD designs are taken from Hadamard matrices. These matrices have excellent qualities for minimizing aliasing between important effects such as control-by-noise interactions.

14:00-14:15 **Observing the Chaotic Dynamics and Embedded Attractor of a Water Drip Apparatus**, Jiya Janowitz (ASMSA)

Mentor Charles Mullins

Abstract The flow rate of a water drip apparatus was recorded at different pressures, a bifurcation diagram was created which plotted the system's behavior. A three dimensional model of the system's chaotic behavior was created with embedding. The resulting attractor appears to be undiscovered, and may be unique to this kind of system. My talk will elaborate on the results of this experiment, it's potential for bringing chaos to the classroom, and possibilities for further applications of the attractor.

UNDERGRADUATE TALKS, Keplinger Hall, Room M8 Presiding: Nicholas Zoller (SNU)

13:00-13:15 **Algorithm for Acquiring Friendly Pairs**, Austin Himschoot (ASMSA)

Mentor Charles Mullins

Abstract Friendly numbers, introduced in the 1970s by C.W. Anderson and Dean Hickerson, are numbers that share a common abundance with another number. The abundance of a number is equal to the summation of all factors of that number divided by the number itself. Because friendly numbers is a rather new topic, it seems that only a few friendly pairs have been found. I wrote a computer program using Java and found, I believe, some new friendly numbers. In my talk, I will present my results.

13:20-13:35 **Mathematical Observations of Ventral Horn Cells in Xenopus Laevis**, Lance Ford (UCO) and Brittany Myers (UCO)

Mentor Brittany Bannish

Abstract The number of cells in the ventral horn region of the African clawed frog has been recorded in a paper by M.C. Prestige. The cells can be either living or degenerating. In our research, we attempted to use the data to model the behavior of cells in the ventral horn using age-structured partial differential equations. We discovered that this was not the best modeling framework for this particular problem, so we used a system of ordinary differential equations instead.

13:40-13:55 **Using Centrality to Predict Movement of Stock Prices**, Bryant Wilson (ORU)

Mentor Andrew Lang

Abstract The purpose of this paper is to use various centrality measures to predict movement of stock prices. It has been shown that a social network can be created by knowing only membership within groups. Here a network is created using the words found in annual regulatory 10-K reports filed with the US Securities and Exchange Commission. The method was correct in predicting up to 81% of stocks price changes.

14:00-14:15 **Closed-Form Representations for Exponential Forms**, Nicole Nichiniello (UAM)

Mentor Juan D. Serna

Abstract It is well known in mathematics that an analytic function of a linear operator can be casted as an infinite sum if the operator is represented by a non-singular matrix, and the function admits a Maclaurin expansion. Typical examples of this are the Baker-Campbell-Hausdorff (BCH) series and the matrix exponential often used in quantum optics. It can be shown that, by using the Cayley-Hamilton theorem, these power series can be reduced to a finite number of terms without the need of simply truncating the series to obtain an approximation. In this work, we present some techniques used to derive closed-form expressions for analytic functions of linear operators defined on unitary spaces of dimension 2 and 3 over the field of complex numbers.

UNDERGRADUATE TALKS, Keplinger Hall, Room U3 Presiding: Kristi Karber (UCO)

13:00-13:15 **Investigating Home and Foreign Primes**, Anderson Depee (SNU)

Mentor Nicholas Zoller

Abstract Take the prime factorization of a positive integer n, and concatenate the primes in non-decreasing order. If this new integer is prime, then it is the home prime of n, otherwise repeat the process with this new integer until a prime number is obtained. To find the foreign prime of a positive integer n, we will do the same process, but arrange the prime factorization in non-increasing order. If this new integer is prime, then it is the foreign prime of n, otherwise repeat the process on the new integer until a prime number is obtained. In this talk I will discuss properties of home and foreign primes.

13:20-13:35 **When Greed is Good: Characterizing Robustness of Myopic Algorithms for the Budget-constrained Multi-Armed Bandit Problem**, Sam Beckmann (TU)

Mentor Sandip Sen

Abstract The multi-armed bandit (MAB) problem with budget constraints involves pulling arms with stochastic rewards and costs with the goal of maximizing the total reward generated from those pulls in a given budget. Algorithms of varying complexity have been proposed to address this problem. We show that a computationally frugal myopic approach can be competitive under certain circumstances. The results have direct implications for effective application of MAB algorithms in problems of practical import.

13:40-13:55 **Bayesian Approach to the Simple Linear Regression Analysis**, Samuel P. Cowgill (ASU)

Mentor Seo-eun Choi

Abstract The Ordinary Least Square (OLS) estimation is the simplest way to estimate parameters in linear regression analysis. The Generalized Least Square (GLS) estimation could be used in case OLS does not work with missing data. However both require independence among observations in addition and treat parameters as unknown constants. In this presentation, we introduce the Bayesian approach to linear regression as an alternative. The comparison between OLS, GLS and Bayesian approach is provided too.

UNDERGRADUATE TALKS, Keplinger Hall, Room U8 Presiding: Jill Guerra (UAFS)

13:00-13:15 **A Discussion of the Proof of the Uncertainty Principle of Quantum Mechanics**, Andrew Best Jr. (UA)

Mentor B. Madison and J. Woodland

Abstract This will be a discussion of the derivation and proof of the uncertainty principle of quantum mechanics. A discussion of the implications of the principle will be included, and some common misconceptions will be addressed.

13:20-13:35 **Vector-Matrix Representations of Non-Associative Moufang Loops of Order 2n**, Kyle B. Reeves (ECU)

Mentor Andrew Wells

Abstract Moufang loops are quasigroups which contain an identity element and satisfy the Moufang identities. A method published by Orin Chein details the construction of non-associative Moufang loops of order 2n from non-Abelian groups of order n. The feasibility and utility of representing certain of these with vector-matrices is examined.

13:40-13:55 **Logistic Regression Analysis on the Effects of College Algebra on College Students**, Emily Hubbard (ASU)

Mentor Seo-eun Choi

Abstract We want to analyze the relationship of the variables that may affect students while taking College Algebra. The results will be presented to the Department of Mathematics and Statistics as well as the Arkansas Department of Education, to help enhance College Algebra. Once we get a random sample from universities in Arkansas, the relationship among the variables will be analyzed using logistic regression. Logistic regression will be introduced, then the outline of our research will be presented.

UNDERGRADUATE TALKS, Keplinger Hall, Room U9 Presiding: Jeanine Myers (UAFS)

13:00-13:15 **A Study of the Effects of Virtual Manipulatives and Animations for Calculus Labs**, Cyrus Koch (UCA) and Katie Burden (UCA)

Mentor Jason Martin

Abstract Instead of representing continuous change on an unmoving image, animations and virtual manipulatives (VM) have the capability to show change in real time. With this in mind animations and VMs were constructed to support a series of calculus labs targeting limit, derivative, and definite integral. We asked, 'What effects do contextual and graphical interactive images have on student understanding?' Preliminary results indicate some possible differences in how students interpret these images.

13:20-13:35 **Major League Baseball Stadiums vs. Batting Success**, Shane Luttenberg (OWU)

Mentor Brian Turner

Abstract One of the charms of major league baseball is the uniqueness of its stadiums, which includes geographical setting, weather, altitude, and even the individual size and shape of the playing field. Our mathematical quest was to explore the statistical correlations between various factors of each stadium versus the success rate for batters, compiled from 10-year data of batting averages, doubles, triples, and home runs. In particular, we analyzed the fair territory of each stadium, average wind-speed and direction, temperature, altitude, and the minimum speed to hit a centerfield home-run (based upon a Runge-Kutta numerical model).

13:40-13:55 **Travel Optimization for the GAC**, Jared Galbraith (SNU)

Mentor Nicholas Zoller

Abstract What do anvil salesmen and basketball teams have in common? They both spend quite a bit of time traveling around the country. In both cases, optimizing their travel can save quite a bit of time and money. In this talk, I will discuss the Traveling Salesman Problem and how it can be used to optimize travel for basketball teams and salesmen alike.

MATH EDUCATION/CLASS NOTES, Keplinger Hall, Room U372 Presiding: Lisa Mantini (OSU)

13:00-13:15 **Both Factual and Well-Known**, Janet C. Woodland (UA)

Abstract Who can complain when students remember what they've been told? When we refer to "well-known facts" it is often without proof, which means most people remember the "rule" but don't really understand why it holds. I will present a brief list of WKFs with both supporting evidence and counterexamples.

13:20-13:35 **MAA CUPM: Past, Present, and Future**, Linda Braddy (MAA)

Abstract Founded in 1915, MAA has a long history of working to improve the teaching and learning of undergraduate mathematics. This presentation will highlight the work of MAA's Committee on the Undergraduate Program in Mathematics (CUPM) since its inception in the 1950s.

13:40-13:55 **The MAA's CUPM Guide to the Math Major**, Lisa Mantini (OSU)

Abstract A successful Math major should offer a program of courses that gradually lead students from basic to advanced levels of critical and analytical thinking while encouraging creativity and excitement about mathematics. The MAA has been at the forefront of recommendations for the undergraduate curriculum for many years. This talk will present a summary and highlights from the 2015 revision of the MAA's CUPM Curriculum Guide to Majors in the Mathematical Sciences.

14:00-14:15 **CUPM: Ask Questions, Get Answers!**, Linda Braddy (MAA) and Lisa Mantini (OSU)

Abstract The presenters will provide answers to questions posed by the attendees as a result of the above two talks. Hopefully you will find something to carry home to your own department!

14:15-14:30 **BREAK – Enjoy visiting for a few minutes!**

14:30-15:50 **EXECUTIVE COMMITTEE MEETING**

EDUCATIONAL TECHNOLOGY, Keplinger Hall, Room M2 Presiding: Sarah Marsh (OBU)

14:30-14:45 **Incorporating YouTube Videos Into Your Teaching**, Marcel B. Finan (ATU)

Abstract It has been argued that most students respond well to visual learning (i.e., sounds and images), stimulating their interest in a subject. One of the most important uses of technology is that it makes it easy for instructors to incorporate multimedia into their teaching. In this presentation, we discuss incorporating videos found on YouTube into classroom notes/slides.

14:50-15:05 **Using Desmos in a Graphing Approach to Algebra**, Ryan Thomas (UA)

Mentor Shannon Dingman

Abstract The benefits of using graphing technology to implement a visual approach to algebra have been well-documented. This talk will focus on they ways that the online graphing utility Desmos can be used to improve student engagement and conceptual understanding. In addition, several examples of activities in Desmos suitable for a college algebra (or similar) classroom will be presented.

15:10-15:25 **Reflections on Teaching Online Courses**, Sarah Marsh (OBU) and Krista Hands (OBU)

Abstract The prospect of 'online' teaching carries with it a variety of logistics to navigate and issues to consider. In this talk, we will explore some of the choices we have made in implementing selected mathematics courses in an online format. We will also discuss some of the issues we have encountered throughout the process and some of the safeguards we have put in place to protect the integrity of these courses.

15:30-15:45 **Tablet and iPad Applications in Mathematics Education**, Razieh Shahriari (UA)

Mentor Shannon Dingman

Abstract Tablets and applications (apps) have great potential in education due to their ease of usage as well as the portability of the devices. In this talk we illustrate the effectiveness of tablet apps in constructing interactive teaching and learning in mathematics. We present useful apps that enhance the teaching and learning process, and we will emphasize types of apps that are useful for teaching different aspects of mathematical concepts such as fractions and graphing on the coordinate plane.

MATH EDUCATION/CLASS NOTES, Keplinger Hall, Room M8 Presiding: Charles Cooper (UCO)

14:30-14:45 **Quantitative Reasoning: Alternatives to Traditional College Algebra**, Rachel Bates (RCC)

Abstract This presentation will provide participants with the opportunity to discuss the importance of providing alternative general education pathways for non-STEM students. Given the significant role that algebra has had within middle school mathematics (and beyond), it is important as mathematics educators that we understand and discuss the skills that all students should develop to effectively engage in their long term role of citizenry. The role of quantitative reasoning has gained attention and has become more prominent among higher education institutions (embedded within traditional general education courses and mathematics courses). Advocates of quantitative reasoning suggest that current STEM pathways do not adequately prepare students for civic participation. A discussion of quantitative reasoning and example course designs will be presented.

14:50-15:05 **What are the Rules? An Intuitive Approach to Numbers and Operations for Preservice Elementary Teachers**, Jennifer Paulk (UA)

Abstract "I love math. All you have to do is follow the rules and you don't need to really understand it. I'm really good at following rules!" - A. Student ..... This talk will discuss mathematical methods, their connection to various mathematical properties, and how to create useful tag lines in order to communicate the mathematics behind the methods.

15:10-15:25 **A Topological Definition of Limit for Use in Elementary Calculus**, Charles Cooper (UCO)

Abstract In the talk we discuss an alternative to the standard $\delta - \epsilon$ definitions for the various types of limits defined in elementary calculus that can greatly simplify limit verification by use of the definition as well as limit theorem verification. The basic idea is to replace the intervals that are centered about the relevant points in the domain and range, as demanded by the $\delta - \epsilon$ definition, with arbitrary open intervals. In the talk we will illustrate the use of this definition for verifying specific limits, such as $\lim_{x \to 2} x^3 = 8$ and the verification of a limit such as the constant multiple theorem.

15:30-15:45 **Math Placement Test Meets Math Boot Camp**, Brandon Crisel (UA), Elizabeth Keiffer (UA), and Deborah Korth (UA)

Abstract Traditional math placement tests only take a "snap shot" of a student's ability to perform on a multiple choice test. In contrast, the UofA Math Placement Assessment is a two part system consisting of placement tests containing mainly free-response questions and a customized self-remediation component. Not only does this system help identify the proper course in which a student is to enroll, it also gives the students experience in using course materials necessary to be successful in class.

RESEARCH IN MATH EDUCATION, Keplinger Hall, Room U3 Presiding: Jason Martin (UCA)

14:30-14:45 **Business Faculty Perceptions of the Calculus Content Needed for Business Courses**, Melissa Mills (OSU)

Abstract The MAA's Curriculum Reform Across the First Two Years project recommended that Business Calculus contain more emphasis on modeling and interpretation of solutions and less emphasis on computation and symbolic manipulation. They also state that "When in doubt, mathematics faculty should cover less material" (Lamoreux, 2000). Adding in more modeling and applications must require cutting out some topics that are traditionally covered. This study presents results from a survey of business faculty and interviews with seven business faculty at a large comprehensive research institution regarding the Calculus content that they perceive as necessary for business students to succeed in their subsequent courses. One result is that the business faculty found partial derivatives to be more pertinent for their students than integration.

14:50-15:05 **Pedagogical Challenges of Communicating Mathematics With Students: Living in the Formal World of Mathematical Thinking**, Sepideh Stewart (OU)

Abstract In this paper we examine an Abstract Algebra professor and one of his students' thought processes simultaneously as the class was moving toward the proof of the Fundamental Theorem of Galois Theory. We employed Tall's theory of three worlds of mathematical thinking to trace which route (embodied, symbolic, formal) the mathematician was choosing to take his students to the formal world. We will discuss the pedagogical challenges of proving an elegant theory as the events unfolded.

15:10-15:25 **Gains from a Unified Conceptual Approach to Calculus Instruction**, Jason Martin (UCA) and Micheal Oehrtman (OSU)

Abstract We document students' conceptual gains from first and second semester calculus classes systematically implementing a sequence of labs introduced in the faculty workshop. These labs leverage an approximation approach that research has indicated can support a productive and coherent conceptual foundation for students' reasoning about concepts defined in terms of limit. Pre-test and post-test data indicate conceptual gains above the gains previously observed from students taught without these labs.

GENERAL, Keplinger Hall, Room U8 Presiding: Carolyn Eoff (HSU)

14:30-14:45 **The Multiplicity of Solutions for a Class of Fourth Order Differential Equations**, Britney Hopkins (UCO) and Thomas Milligan (UCO)

Abstract In this talk we consider a method of a acquiring the existence of positive solutions for a particular class of fourth order differential equations. We do this by transforming the equation into a system of second order equations satisfying homogeneous boundary conditions. We then give a series of lemmas that establishes estimates on a defined operator. This in turn allows for the multiple application of the Guo-Krasnosel'skii Fixed Point Theorem, guaranteeing several solutions.

14:50-15:05 **Worst Hitters in Major League History**, Fred Worth (HSU)

Abstract Baseball research typically focuses on the best in various categories. We will instead consider who the worst hitters have been in major league history. Different metrics will be considered based on what has been valued in baseball over the years.

15:10-15:25 **Some Elementary Methods for Exponential Diophantine Equations**, Roberto R. Rivera (SWOSU)

Abstract Certain nontrivial exponential Diophantine equations will be examined and elementary methods for their resolution will be described and illustrated. The methods, while not proven to always be successful, empirically should always or almost always be successful. For example, combining the theory of Pell equations with modular congruences can completely resolve the equation $5^m = n^2 + 1$ in positive integers. For such equations, the modern state of the art typically involve Baker's method and linear combinations of logarithms of algebraic numbers, but frequently much more elementary methods work. This talk will illustrate such methods.

15:30-15:45 **Who gets the ball? A Brief Look at Competitive Implications of Alternating Possession**, Andrew Wells (ECU)

Abstract In a traditional basketball game, when a team scores, the other team is awarded possession. It is common, however, in pick-up basketball that the team that scores is awarded possession instead. This presentation examines whether this choice impacts the probability of either team winning a 'first to n points' style contest. These results are obviously generalizable to any competitive game of this type.

MATH EDUCATION/CLASS NOTES, Keplinger Hall, Room U9 Presiding: Michael Dougherty (SWOSU)

14:30-14:45 **The Tulsa Math Teachers' Circle**, Marilyn Howard (TU), William Coberly (TU), and Donna Farrior (TU)

Abstract The Tulsa Math Teachers' Circle started in the fall of 2013, hosted by the University of Tulsa Department of Mathematics and the College of Engineering and Natural Sciences. In this session we'll explain what a math circle for teachers is and how to start one. Also we'll discuss funding, topics for sessions and resources, the growing math circle movement, and lessons we've learned in conducting our teachers' circle.

14:50-15:05 **Experiences With Teaching Online, Hybrid, and Flipped Classes**, Jack Jackson II (UAFS)

Abstract For the past several years Dr. Jackson has taught university classes in College Algebra, Trigonometry, Probability and Statistics, and Calculus with significant online components. Formats for the classes have included flipped classes with traditional meeting times, hybrid classes meeting with half the traditional meeting time, and full online classes. In this talk Dr. Jackson will give an overview of some of his methods and will reflect on some of the technological and pedagogical challenges and opportunities.

15:10-15:25 **The Tulsa Girls' Math Circle**, Donna Farrior (TU), Marilyn Howard (TU), and Willliam Coberly (TU)

Abstract The Tulsa Girls' Math Circle started at The University of Tulsa after the successful initiation of the Tulsa Teachers' Math Circle. In this session we'll discuss what a math circle is and why we started a math circle for middle school girls. We'll also talk about format of our sessions, topics and resources, recruitment, and mentors.

15:30-15:45 **Benefits of early rigor and a limit "forms" emphasis in Calculus I**, Michael Dougherty (SWOSU)

Abstract Presented is an approach to teaching Calculus I using a stronger emphasis on early rigor: more ϵ-δ proofs, quantified definitions of limits of various types, and a rigorous discussion of limit forms, both indeterminate (e.g. $0/0$, ∞/∞, $0\cdot\infty$ and $\infty-\infty$) and "determinate" ($\infty+\infty$, $1/\infty$, $1/0^+$, $1/0^-$, and others). Useful notational devices will also be discussed. With extra time spent on limits and continuity, sophistication is increased early, and later topics are relatively straightforward.

16:00-17:00 **MAA SECTION VISITOR LECTURE**, **Keplinger Hall, Room M1**

Polyhedral Symmetry in the Plane? Frank Farris, Santa Clara University

Abstract When we classify plane patterns by their symmetries, there is a famous trichotomy: plane patterns may be rosettes, friezes, or wallpaper patterns. The symmetries of a rosette all share a single point; a frieze pattern is invariant under translation in one direction, a wallpaper pattern in two. In this talk, we undercut tradition, which normally insists that symmetries must preserve distances. We allow certain distance-deforming transformations to play the role of symmetries. In particular, we show how the polyhedral groups can act on the plane. To make patterns with these new transformations as symmetries, we construct functions invariant under the polyhedral actions. This talk, accessible to undergraduate mathematics students, combines a little group theory, a little complex analysis, and several other ingredients in the service of mathematics and art.

Bio Frank A. Farris has taught at Santa Clara University since 1984. After receiving his PhD from MIT in 1981, he served as Tamarkin Assistant Professor at Brown University for three years. A native Californian, Farris graduated from Pomona College in 1977. He edited *Mathematics Magazine* from 2001 through 2005, and again in 2009. He remains active in the Mathematical Association of America and has just completed a term as the chair of their Council on Publications and Communications. In 2011, Farris enjoyed a term as Benedict Distinguished Visiting Professor at Carleton College.

17:15-18:00 **STROLL THROUGH THE GALLERIES**, **Gilcrease Museum**

18:00-19:30 **BANQUET – BUFFET STYLE**, **Gilcrease Museum, Vista Room**

Caesar Salad	Dinner Rolls
Pecan Crusted Chicken	Bourbon Bread Pudding
Rice Pilaf	Iced Tea
Seasonal Vegetables	Iced Water

19:45-20:45 **N.A. COURT LECTURE**, **Gilcrease Museum, Vista Room**

Competitive Exclusion and Coexistence in Population Models Azmy S. Ackleh, University of Louisiana at Lafayette

Abstract/Bio A separate brochure will be available at the Lecture.

20:45-21:15 **STROLL THROUGH THE GALLERIES**, **Gilcrease Museum**

Saturday, 11 April 2015

8:00-9:10 **SECTION BUSINESS MEETING**, **Keplinger Hall, Room M1**

8:00-12:00 **REGISTRATION**, **Keplinger Hall, Lower Lobby**

8:00-12:00 **BOOK SALES, EXHIBITORS, REFRESHMENTS**, **Keplinger Hall, Room U376**

9:15-11:00 **INDIVIDUAL INTEGRATION BEE**, **Keplinger Hall, Room M1**

ANALYSIS, Keplinger Hall, Room M2 Presiding: Dale Alspach (OSU)

9:30-9:45 **Change of Variables from u-Substitution to Radon-Nikodym**, Nicholas Jacob (ECU)

Abstract Change of variables permeates through all of integration. U-substitution, polar coordinates, and the Jacobian give way to the more abstract constructions of the Radon-Nikodym derivative and the Besicovitch derivation theorem.

9:50-10:05 **Alternative Proofs of Some Properties of the Rarita-Schwinger Operator and the Higher Spin Laplace Operator**, Chao Ding (UA)

Mentor John Ryan

Abstract In spinor valued function theory, the Dirac operator and the Laplacian are both conformally invariant. But they are not conformally invariant anymore in higher spin theory. That is where the Rarita-Schwinger operator and higher spin Laplace operator fit in. In this talk, you will see some properties of these operators. We will discuss the conformally invariant higher order differential operators in the higher spin theory.

10:10-10:25 **Rarita-Schwinger Operator on Hyperboloid**, Wanqing Cheng (UA)

Mentor John Ryan

Abstract In this talk we deal with Rarita-Schwinger type operators on the Hyperboloid. First we define the hyperbolic Rarita-Schwinger type operators and construct their fundamental solutions. Then we establish that the hyperbolic Rarita-Schwinger type equations are conformally invariant. Further, we obtain some basic integral formulas related to the hyperbolic Rarita- Schwinger type operators.

10:30-10:45 **Johann Bernoulli's Brachistrochrone Challenge and the Birth of Calculus of Variations**, Nikola Petrov (OU)

Abstract As it often happens in the history of Math and Science, the initial development of the calculus of variations was fueled by passions between its creators. In this talk we will discuss the famous problem of the brachistochrone, posed by Johann Bernoulli to all mathematicians, and the solutions of some of the greatest mathematicians of the day. We will present the beautiful solution of this mechanical problem by Johann Bernoulli, who used Fermat's ideas from optics. The talk is accessible to everybody who knows what a derivative is.

GENERAL, Keplinger Hall, Room M8 Presiding: John Diamantopoulos (NSU)

9:30-9:45 **Humor in the Classroom**, John C.D. Diamontopoulos (NSU)

Abstract We've all had those students for whom it's especially hard to grab their attention, sometimes this seems especially difficult in lower-level general education classes. I think humor is one of the best ways to grab, and keep their attention! Especially in my general education type classes, I'll try to play a funny math video clip at the beginning of class. This has sometimes continued well into the semester and even morphed to students sending in their picks for "funniest video of the week" that I'll play instead of one of mine. Come and hear some of this wonderful math class humor!

9:50-10:05 **Using Graph Coloring to Solve Sudoku Puzzles**, Michelle A. Lastrina (ECU)

Abstract Do you enjoy completing the Sudoku puzzles that can be found in your daily newspaper? Did you know that a Sudoku puzzle can be represented as a graph coloring problem? In this talk, we will introduce the basic graph theory knowledge needed to solve such a problem and see how a Sudoku puzzle can be transformed into a graph coloring problem, then solved.

10:10-10:25 **A Triple Application of the Guo-Krasnosel'skii Fixed Point Theorem**, Britney Hopkins (UCO) and Kristi Karber (UCO)

Abstract In this talk, we apply the Guo-Krasnosel'skii Fixed Point Theorem three times to verify the existence of multiple positive solutions to a $2n$th order differential equation with right focal boundary conditions. This is accomplished by converting the even order problem into a system of second order differential equations satisfying homogeneous boundary conditions prior to applying the aforementioned fixed point theorem.

10:30-10:45 **Euler's Intuitive Approach to the Basel Problem and an Infinite Product**, Michael C. Fulkerson (UCO)

Abstract In this talk we will explore some of the Euler's most famous results, including his solution of the Basel problem and an infinite product.

APPLIED MATHEMATICS, Keplinger Hall, Room U3 Presiding: Michael Lloyd (HSU)

9:30-9:45 **Statistical Analysis of Evergreen Invaders**, Michael Lloyd (HSU)

Abstract The reproductive status, height, and distribution of seven types of invasive evergreens were analyzed using the statistical software R. In Arkansas, about 23% - 26% of the flora consists of non-native species (Arkansas Vascular Flora Committee 2006). Some of the most invasive plants in the southeastern United States are woody ornamentals like the ones studied in this paper. This was a collaborative effort with a Henderson State University undergraduate student and a biology professor.

9:50-10:05 **An Anomaly In the Flight Path of a Volleyball**, Tom Cairns (TU)

Abstract The flight path of a volleyball during play depends on, among other factors, the atmospheric conditions of the court at the time. The common wisdom would be that a ball served at a high altitude would travel farther and faster than the same serve at sea level. This work shows that there are special atmospheric conditions under which that is not true.

10:10-10:25 **A Look at Actuarial Pricing - Disability Insurance**, Stephanie Johnston (OSU)

Mentor Michael Oehrtman

Abstract I would like to offer a glimpse into the world of actuarial work, specifically from the pricing perspective. This presentation will give a basic example of pricing for disability insurance, with some additional information about other actuarial analysis that would be performed for other aspects of pricing and reserving models.

10:30-10:45 **The Fourier-Finite Element Method for Coupled Thermo-Chemo-Poroelastic Systems**, Tetyana Malysheva (OU)

Mentor Luther White

Abstract We present a numerical method for coupled parabolic-elliptic initial-boundary value problems for systems modeling fully coupled thermal, chemical, hydraulic, and mechanical processes in porous media that impact borehole stability. The method is based on the proposed hybrid Fourier-finite element approximation technique that involves a boundary penalization strategy and captures borehole geometry and mechanics. The method allows numerical analysis of a borehole boundary control problem which aims to achieve the desired stresses in the neighborhood of the borehole.

GENERAL, Keplinger Hall, Room U8 Presiding: Tom McNamara (SWOSU)

9:30-9:45 **Integrating Discontinuous Function**, Tom McNamara (SWOSU)

Abstract We examine the function defined by $F(x) = \int_0^x [t]dt$ where $[t]$ denotes the greatest integer less than or equal to t. From here we will explore the notion of integration as a smoothing process. Also, we will contrast this against differentiation, showing that derivatives are "badly behaved."

9:50-10:05 **Avoiding Gödel's Incompleteness Theorems**, Demitri Plessas (NSU)

Abstract Many consider Gödel's Incompleteness Theorems to be the two most important theorems of the twentieth century. Informally, they state that any axiomatic system that contains Number Theory has propositions that cannot be shown true or false, and the system cannot be shown to be contradiction-free from within the system itself. In this talk, we will highlight recent attempts to create weaker complete axiomatic systems for Euclidean Geometry, Set Theory, Topology, and Graph Theory.

10:10-10:25 **Sparse Discriminant Analysis of fMRI Functional Connectivity Data**, Maria Puhl (TU)

Mentor William Coberly

Abstract Sparse Discriminant Analysis (SDA) is a classification method useful in high dimensional settings, that is, when the number of predictor variables is significantly greater than the number of observations. Rather than performing feature selection followed by classical discriminant analysis in low dimensional space, SDA performs feature selection and classification simultaneously. This study explores the use of SDA when applied to fMRI functional connectivity resting state data from 31 subjects diagnosed with autism spectrum disorder and 29 neuro-typical subjects. The data for each subject is based on approximately 4000 pairwise partial correlations between 91 seed regions in the brain.

10:30-10:45 **Perfect, Deficient and Abundant Numbers**, Fred Worth (HSU)

Abstract Number theory is one of the most enjoyable areas of mathematics (even if one is a topologist) because topics are often easily accessible, at least on the surface level. Conjectures are easy to come by. Proofs CAN be easy but can be beastly (see Fermat's Last Theorem). In this talk we will look at some examples of theorems involving perfect, deficient and abundant numbers. It is probable that none of these results are new but the author had never seen any of these proofs or conjectures.

ALGEBRA, APPLIED MATH, TOPOLOGY, Keplinger Hall, Room U9 Presiding: Anita Walker (ECU)

9:30-9:45 **A Bill- and Web-Based System of ODEs**, Anita Walker (ECU)

Abstract A simple system of ODE's models the pathway of a duck swimming across a river flowing with velocity described by a quadratic function. The subject is accessible to calculus students and extends a problem presented by the author last year.

9:50-10:05 **Nilpotency on gb-Triple Systems**, Guy Biyogmam (SWOSU)

Abstract gb-triple systems were recently introduced as another generalization of Leibniz algebras (which includes Lie algebras) to ternary algebras. In this talk we discuss nilpotency on gb-triple systems. More precisely we discuss how several results well-known in the theory of Lie algebras are extended to gb-triple systems.

10:10-10:25 **Minkowski's Theorem (Geometry in the Aid of Algebra)**, Duff Campbell (HC)

Abstract An important result in number theory is that a prime integer can be written as a sum of squares, $p = a^2 + b^2$, if and only if p is of the form $4k + 1$. Many proofs exist. Minkowski proved this in a novel way, using the geometry of lattices. His proof may be modified to apply to other quadratic forms such as $p = a^2 + 2b^2$, $p = a^2 - ab + b^2$, ... even $p = a^2 + 43b^2$.

10:30-10:45 **Configurations of Robots on a Graph**, James Dover (CU)

Abstract We study the space representing N robots arranged on a track. If the robots have no size, this is the Nth configuration space of a graph. Realistically, robots have size and are not be allowed to overlap. With these sizes, we obtain a restricted configuration space. We consider how this space changes as the sizes of the robots change. What do the spaces look like and how many of them are there (up to homeomorphism or homotopy)? We will focus on the case of two robots (N = 2).

GENERAL, Keplinger Hall, Room U372 Presiding: Krista Hands (OBU)

9:30-9:45 **Local Maximum Modulus Principle**, Swarup Ghosh (SWOSU)

Abstract In the theory of uniform algebra, local maximum modulus principle plays a crucial role. In this talk, we will discuss the principle and some interesting applications of it.

9:50-10:05 **Sparse Network Representation of Functional Connectivity Using fMRI Data**, Alejandro Hernandez (TU)

Mentor William Coberly

Abstract The Graphical Least Absolute Shrinkage and Selection Operator (LASSO) uses L1 regularization to estimate sparse covariance. This algorithm is used to obtain sparse resting-state networks from correlations of fMRI time series data to estimate functional connectivity between regions of interest (ROIs) in the brain. A sparse representation, which forces many correlations to zero, is necessary for the interpretation of the functional connectivity of the brain.

10:10-10:25 **A New Way to Approach The Characterization of Diamond and Lonsdaleite Structures**, Wenwen Li (UCO)

Mentor Michael Fulkerson

Abstract Diamond and Lonsdaleite are two different allotropes of carbon that have hexagonal lattices. Their structures have different symmetry characteristics, but the symmetry alone is not able to fully reflect the differences between Diamond and Lonsdaleite. The purpose of this research project is to determine the topological differences between the two structures. Once it is determined, it can be a revelation of the bond-linking methods for those two diamonds, showing a connection between them.

11:15-12:15 **MAA EDITOR LECTURE**, **Keplinger Hall, Room M1**

The Symmetric Group and Fair Division: Does Knowledge Matter? Brian Hopkins, Saint Peter's University

Abstract Sports drafts and divorce settlements are examples of situations where players take turns selecting indivisible goods. Like other topics in fair division, the situation is made more interesting because people may value the goods in different ways. In this talk, we focus on the case of two players, where the machinery of permutations is surprisingly applicable. How many possible outcomes are there? In what circumstances do both players get their best possible outcomes? How can one best take advantage of knowing the other's preferences? What happens when a player's motivation switches from greed to spite, the common good, or selfless altruism? In this colorful talk, we'll sample some applied algebraic combinatorics and address these issues along with the provocative question of the title.

Bio Brian Hopkins is a professor of mathematics at Saint Peter's University in Jersey City, New Jersey, and teaches game theory and fair division at New York University as an adjunct in the department of politics. He is also active in teacher professional development, especially with the Institute of Advanced Study's Park City Mathematics Institute. Research interests include combinatorial number theory, Ramsey theory on the integers, and mathematics applied to social science. Hopkins is the editor of *The College Mathematics Journal* and received the 2015 Deborah and Franklin Tepper Haimo Award for Distinguished Teaching of Mathematics.

Ideas To Carry Home

- Submit your presentation as a pdf file to lloydm@hsu.edu for inclusion in the online proceedings.
- Explore the OK-AR Section website http://sections.maa.org/okar/ at least monthly for the rest of the calendar year.
- Check the OK-AR Section website several times a month in the early part of the calendar year to keep up-to-date on the plans being made for the upcoming Section Meeting.
- Donate to the R.B. Deal Fund.
- Start planning for your presentation at next year's Meeting.
- Encourage your colleagues to become active in the Section Meeting.
- Contact jill.guerra@uafs.edu to volunteer as a judge during undergraduate oral presentations
- Contact aw@w5gfe.org to volunteer as a presider during a presentation session on Friday afternoon or Saturday morning (assuming you are not a student)
- Contact the MAA national office at 1.800.331.1622 to verify that your individual profile enables you to receive emails from the Section and from the MAA.

Thank you for coming.

Safe travels as you return home.

See you next year in Arkansas!