Abstracts for Contributed Papers: 2009 Section Meeting

(Note: due to scheduling constraints, some talks may be moved to other sessions)

Session: Undergraduate

Speaker: Brandan Rosa, East Central University
Title: Stability Analysis of Coupled Two-Species Model
Abstract: A model studying inter- & intra-competition for resources between & among two species is presented. Stability conditions for equilibrium points are obtained.

Speaker: Joe Mitchell, University of Oklahoma
Title: Temperature Distribution in a Uniformly Moving Medium
Abstract: We apply several physical ideas to determine the steady temperature distribution in a medium moving with uniform velocity between two infinite parallel plates, including an extensive use of Green's Functions with an emphasis on their physical meaning.

Speaker: Adam Imel, University of Central Oklahoma
Title: A Finite Difference Method for a Mathematical Model of Erythropoiesis Subject to Malaria Infection
Abstract: An implicit finite difference method is developed to numerically solve a system of nonlinear partial differential equations which describes the dynamics of the red blood cell population within a host infected with malaria. A software package was also developed to implement the scheme.

Speaker: Michael Ridener, University of Central Oklahoma
Title: Global Stability of a Stage Structured Population Model
Abstract: We study a model of populations which undergo at least three life stages (e.g. frogs, insects). The model is a system of three nonlinear ordinary differential equations. We assume that the second two stages compete with each other while the individuals in the first stage only experience competition from their own stage. We find conditions on the parameters of the model which guarantee local asymptotic stability of the trivial solution, i.e., conditions under which the model predicts extinction of the population.

Speaker: April Foltz, University of Central Oklahoma
Title: Stability of Rainforest Systems
Abstract: By examining a differential equation model of rainforest systems, trends in rainforest population growth can be found. Specifically, equilibria were looked at to see if they were stable, thereby finding conditions in which the potential of long-term survival is realized. In our differential equation model we have four possible equilibria that are looked at in relation to local and global stability. Once global stability of one equilibrium is proven, conditions are found to ensure the rainforest population will have long-term survival.

Speaker: Ted Swang, University of Oklahoma
Title: Integer Solutions to Descartes Polynomials Associated with Simplicial Graphs
Abstract: Every simplicial graph on n vertices has an associated quadratic polynomial, called the Descartes polynomial, which consists of the sum of the squares of n variables minus twice the cross terms of variables whose vertices are adjacent. I am interested in finding integer solutions to setting these polynomials equal to zero. There exist functions, called swaps, that take one integer solution to another integer solution, thus forming equivalence classes of solutions. Sometimes there exists a "best" representative solution from an equivalence class called a root. I will examine when a root solution exists in an equivalence class.

Speaker: Josh Baldwin, University of Central Oklahoma
Title: Graphs and Zero Forcing Set
Abstract: The zero forcing number Z(G) provides a bound on the maximum corank of graph G over all symmetric matrices with the same zero-nonzero pattern as A(G). I provide an algorithm for finding Z(G) on classes of graphs then define and bound the edge-rank spread of an edge of a graph. These are both used to find the zero forcing numbers of common graphs with an arbitrary edge deleted.

Speaker: Tim Handy, University of Central Oklahoma
Title: Naive Graph-theoretic Mesh Generation and its Applications
Abstract: A naive graph-theoretic method for domain decomposition on two-dimensional domains is developed and presented. The resulting mesh for a given domain is then used to approximate the two-dimensional heat equation over the domain, subject to various Neumann and Dirichlet boundary conditions. The algorithm development is intended to be an introduction to domain decomposition and requires no prior knowledge of mesh generation techniques or high-level mathematics. All graph theory concepts necessary will be explained.

Speaker: John Knorr, Oklahoma State University
Title: Linear Sudoku Solutions and Their Orthogonal Complements
Abstract: Sudoku solutions are function from $Z_3^4 \to Z_3^2$. We use linear algebra over Z_3 to construct a class of linear Sudoku solutions and their orthogonal complements.

Speaker: Devin Smith, University of Central Oklahoma
Title: The life and mathematics of Emmy Noether
Abstract: "In the judgment of the most competent living mathematicians, Fraulein Noether was the most significant creative mathematical genius thus far produced since the higher education of women began." - Albert Einstein. In this talk we will discuss the life and mathematics of Emmy Noether, 1882-1935. She made great progress in the field of abstract algebra as well as in algebraic topology.

Speaker: Ryan Hartman, University of Arkansas – Fort Smith
Title: Using Minitab to Analyze and Reduce Defective Items at a Plant in the Area
Abstract: The student researcher was given actual data from a plant in the local area. The student then imported the data into Minitab to better analyze the data. The student was then able to make suggestions to the plant that may help them run more efficiently.

Speaker: Kayla Murray, University of Arkansas – Fort Smith
Title: Graphs that are Minor-Minimal with Respect to Intrinsically Linked with an Unused Vertex
Abstract: We use one operation, triangle addition, which has been shown to create an intrinsically linked with an unused vertex (ILUV) graph from an intrinsically linked graph. Then, we use ÿ-Y exchanges to generate a list of minor-minimal ILUV graphs. It remains an open question to generate all minor minimal ILUV graphs. Minor-minimal ILUV graphs can be used to create graphs that are minor-minimal with respect to the disjoint linking property.

Speaker: Steven Ellison, Oklahoma Wesleyan University
Title: Lancaster's Model of Conflict: A Modern Look
Abstract: In his historic 1916 paper "*Mathematics in Warfare*," Englishman Frederick Lancaster presented differential equations relating the outcome of a conflict to variables such as force size, attrition, and force effectiveness. We revisit these equations, and check the relevance of his model to current conflicts, including that of Iraq.

Speaker: Nathan Lemay, Oklahoma Wesleyan University
Title: In Search of Poe's Pendulum
Abstract: In these differential equations for the macabre, we rejoin Borrelli, Coleman, and Hobson (*Mathematics Magazine*, *1985*) in their quest to solve for Edgar Allen Poe's deadly pendulum of ever increasing length. We consider variations of their models and incorporate numerical solutions to check the reality of a "terrifically wide sweep."

Speaker: Carlos Bernal, Oklahoma State University
Title: Colorings of Platonic Solids and Representations of the Platonic Groups
Abstract: The symmetry groups of the Platonic Solids have representation in dimensions 1 through 5. All of these may be constructed using variou symmetric colorings of the Platonic Solids.

Speaker: Markus Vasquez, Oklahoma State University
Title: Symmetry Groups of Platonic Solids
Abstract: Given proper coloring, each symmetric rotation of a Platonic Solid can be described as a permutation of faces, vertices or sides. The coloring schemes that lead to this relationship between rotation and permutation have been found.

Speaker: Eric Garber, Southern Nazarene University
Title: The Monty Hall Problem and Variations
Abstract: In my presentation, I will solve the Monty Hall problem using probability and Bayes' Theorem. I will also give two variations of the problem and their solutions.

Speaker: Doug Heltribridle, Oklahoma Wesleyan University
Title: Mastermind Mathematics
Abstract: This is a mathematical look at the game Mastermind, the classic strategy contest between a code maker and code breaker. Following up on the algorithms of D. E. Knuth (*Journal of Recreational Mathematics*, *1976*) and others, we study optimal guessing strategies and the determination of the maximum number of guesses required. We also consider variations in the rules of Mastermind, and evaluate their effect.

Speaker: Ryan Ewing, University of Arkansas – Fort Smith
Title: A Variation of the Competitive Facility Problem
Abstract: This talk expands on the results presented at the 2008 OK-AR MAA meeting in Fort Smith by Dr. Mullins (ASMSA). We consider a variation of the competitive facility problem with two players. In a tournament (simple complete digraph), players label vertices until no more can be labeled: the winner labels the last vertex. We present classes of graphs in which player one wins and classes of graphs in which player two wins.

Speaker: Jonathan Crossley, Oklahoma State University
Title: Computational Analysis of the Delta L- Function _
Abstract: This session will focus on the relationship between the L-function associated to the Ramanujan Delta function and its values upon twisting by Dirichlet characters. In particular, we will focus upon the case where the values at the critical integers are twisted by quadratic Dirichlet characters. The open-source computing package SAGE will be used as evidence towards discovering this relationship.

Session: Graduate

Speaker: Emre Tokgoz, University of Oklahoma
Title: A Hessian Matrix for Functions with an Integer and Real Variable
Abstract: In this paper, we created a Hessian matrix for functions which have discrete and real variables. The importance of such a matrix occurs for problems in applied mathematics (Queueing theory, operations research). An open problem (Global optimization and convexity of M/Ek/1 problem) that has not been solved for approximately 31 years is solved in this paper by the technique that we developed. I believe that the solution to this problem is fairly easy for undergraduate students to understand. This paper is still under review by a journal.

Speaker: Sean Crowell, University of Oklahoma
Title: Detection and Correction of Forecast Bias Errors
Abstract: Forecast models depend heavily on parameters which have been estimated from observations. We present a framework for correcting errors in parameters and initial conditions based on Taylor expansions and verify its efficacy for a simple model problem.

Speaker: Elizabeth Keiffer, University of Arkansas – Fayetteville
Title: Developing Brilliant Professors You Can Understand
Abstract: This presentation will discuss a NSF funded program which places graduate math and science students in middle school classrooms with the major goal of improving their communication skills. Communication skills are impacted through lesson development with teachers and lesson facilitation to students. Subsequent results are future professors who can explain difficult material at a basic level and an increase in pedagogical knowledge.

Speaker: Dane Womack, University of Central Arkansas
Title: Improved Capture/Recapture Methods for Detecting Unequal Catchablility in Biological Populations
Abstract: Petersen type population estimators usually assume equal catchablility – every individual in a population has the same likelihood of being observed during multiple capture /recapture attempts. A common method of detecting unequal catchability uses approximate Chi-squared statistics, where the number of recaptures is large enough to assume approximate normal distributions for each individual. The author develops a test, based on as few as two capture-recaptures, that avoids using Chi-Square distributions.

Session: General

Speaker: Nikola Petrov, University of Oklahoma
Title: Dimensional analysis in physics, or How to attack a physics problem that we don't understand
Abstract: We give a brief outline of the methods of dimensional analysis in physics and some of its elementary applications.

Speaker: Darryl McCullough, University of Oklahoma
Title: On the matrices AB and BA
Abstract: We will discuss functions of matrices that have the property that $f(AB) = f(BA)$.

Speaker: Evan Linde and Darryl Linde, Northeastern State University
Title: The Great Internet Mersenne Prime Search
Abstract: A discussion of how the Great Internet Mersenne Prime Search works, how to get involved, and how to form a team.

Speaker: Fred Worth, Henderson State University
Title: Strong Law of Small Numbers
Abstract: Martin Gardner and Richard Guy did some delightful work with the "Strong Law of Small Numbers" which says "There aren't enough small numbers to meet the many demands made of them." In this talk we will look at some examples of this law from a couple of papers written by Richard Guy.

Session: Algebra

Speaker: David Wright, Oklahoma State University
Title: Really Odd Binomial Coefficients
Abstract: We describe some investigations arising from a Monthly problem of Montgomery and Shapiro on $\binom{-1/3}{n}$. At the same time, we extol the joy of Monthly Problems.

Speaker: Daniel Pinzon, University of Arkansas - Fort Smith
Title: It's a Supermathematical World
Abstract: Supermathematics is an attempt to redefine classical mathematical objects to model physical particles that have both integer (bosons) and half-integer (fermions) spin. This is done at the infinitesimal level by grading the vector space $V = V^{even} \oplus V^{odd}$ and in any classical formula where two odd elements are interchanged, a minus sign is introduced. We discuss the consequences of these changes and what physical predictions they make.

Speaker: Boris M. Schein, University of Arkansas – Fayetteville
Title: Syntactic monoids
Abstract: Syntactic monoids is the second most applicable direction of semigroup theory (the first is semigroups of transformations). It is used in mathematical linguistics. We'll discuss what are the "parts of speech" (like nouns, adjectives, verbs, proverbs, pronouns, etc., etc.)

Session: Analysis

Speaker: Tom McNamara, Southwestern Oklahoma State University
Title: Using Special Functions
Abstract: We will show by example how the classical special functions can serve to introduce students to Lie Algebras and Lie Groups.

Speaker: Paul Goodey, University of Oklahoma
Title: Concentration: Are the Polar Caps Getting Smaller?
Abstract: We will discuss some surprising aspects of standard spherical Lebesque measure.

Speaker: Keri Kornelson, University of Oklahoma
Title: Sierpinski's gasket and iterated function systems
Abstract: An iterated function system (IFS) is a finite collection of contractive maps on a complete metric space. An IFS has an invariant set, called the attractor, that displays self-similarity and often will be a fractal with non-integer Hausdorff dimension. In this talk, we will show how to construct Sierpinski's gasket as an IFS attractor.

Speaker: Mehmet Celik, University of Arkansas – Fort Smith
Title: An observation on a sufficient condition for compactness of the $\bar{\partial}$ - Neumann operator
Abstract: Solving the inhomogeneous Cauchy-Riemann equations, $\frac{\partial u}{\partial \bar{z}} = v$, is a fundamental problem in Several Complex Variables. One of the ways to obtain a solution is through inverting the complex Laplacian. Properties of the $\bar{\partial}$ - Neumann operator (the inverse of the complex Laplacian) are determined by the interplay between the complex geometry of $\mathbb{C}^n$ and the geometry of the boundary of a domain. A result related with one of the sufficient conditions for the compactness (regularity) of the operator will be presented.

Session: Topology

Speaker: Andrew Bucki, Langston University
Title: Para-f-Lie Groups
Abstract: In this presentation I will show how to study topological and geometrical properties of some topological groups by means of purely algebraic methods of Lie algebras of these groups.

Speaker: Andy Miller, University of Oklahoma
Title: Parabolic modular triangles
Abstract: An ideal triangle in the hyperbolic plane {z| Im(z)>0} is a parabolic modular triangle if its three vertices are rational points on the extended real line. Two such triangles are equivalent if there is a linear fractional transformation with integer coefficients (that is, an element of the modular group PSL(2,Z)) carrying one to the other. Each side in a parabolic modular triangle can be assigned a length and each angle can be assigned a measure. We will describe these invariants and then discuss basic principles of triangle geometry such as the angle/angle/angle law.

Speaker: Leonard Rubin, University of Oklahoma
Title: Direct Systems
Abstract: Direct sequences and direct systems in topology will be defined. We will discuss their limits.

Session: Applied Math

Speaker: Thomas Cairns, University of Tulsa
Title: Motion analysis computer software demonstrated in a sample analysis of a sport skill
Abstract: One of the burgeoning fields of mathematical application is biomechanics. Notable examples are industrial biomechanics (e.g., repetitive motion syndrome prevention), medical biomechanics (e.g., modeling lower extremity responses to automobile crashes) and sports biomechanics (e.g., analyzing sports techniques). Motion analysis computer software has evolved as the principle analytic tool available to the biomechanist. In this talk I will demonstrate the process of using Ariel Performance Analysis System (APAS) from Ariel Dynamics and will show graphical and other output obtained in a sample analysis of a sport skill.

Speaker: Jeremy Thibodeaux, University of Central Oklahoma
Title: Modeling Erythropoiesis Subject to Malaria Infection
Abstract: A mathematical model of erythropoieis (red blood cell production) within a host infected with malaria is developed. This model takes the form of a system of nonlinear first-order hyberbolic partial differential equations. An existence-uniqueness result is established via an implicit finite difference scheme. Numerical simulations that suggest new treatment strategies will also be presented.

Speaker: Michael Lloyd, Henderson State University
Title: Zeros of a Polynomial via the QR Factorization
Abstract: A method for approximating all the zeros of a polynomial using the QR matrix factorization and its coding on the TI-nspire is explained.

Speaker: Robert Ferdinand, East Central University
Title: Finite Element Solutions of Groundwater Contaminant Model
Abstract: Galerkin finite element method is used to approximate a solution of a model that describes the dynamics of contaminant in groundwater.

Speaker: David Peterson, University of Central Arkansas
Title: Improved Petersen Estimators for Population in Capture /Recapture Methods
Abstract: The basic Petersen estimate for population is $N = (M+1)(C+1)/(R+1) - 1$, where C is the number of marked individuals out of the total population N, and R is the number of marked individuals out of M captures in one sampling. The simplicity of this method makes this a common tool. Unfortunately, the standard deviation for this estimate is large. But if the initial marking is the result of an initial sample, this additional information (and any subsequent additional recaptures) can be used to significantly reduce the standard deviation for estimates for N, with little more computational complexity.

Session: Mathematics Education and Classroom Notes

Speaker: Douglas B. Aichele, Oklahoma State University
Title: Computer Assisted College Algebra - A Preliminary Study Report
Abstract: We are experimenting with the development of a computer assisted College Algebra program at OSU using MyMathLab. A mixed-model study was conducted during the 2008 Fall semester involving approximately 1400 students. In this session I will discuss the motivations for considering a computer assisted College Algebra experience, describe the model that we developed, and present some preliminary findings of our study.

Speaker: Anita M. Walker, East Central University
Title: Screens and Genes: Do You See What I See ???
Abstract: It is known that the incidence of color-blindness in a student population can have significant impact on the perception of classroom materials. This presentation offers examples of problematic images and includes the results of a testing activity conducted by the presenter at East Central University.

Speaker: Clyde Greeno, MALEI Mathematics Institute
Title: Reforming "Developmental Mathematics": Visions of an "Empowerment" SIG-MAA
Abstract: It long has been presumed that most collegiate courses in mathematics are intended partly to empower mathematics students for genuine personal academic success in subsequent courses. That presumption prevails especially in the core-curricular courses – "developmental" arithmetic and algebra, through college algebra, basic statistics, and introductory calculus. But throughout that spectrum, the high rate of attrition warrants growing concerns of governments, of institutions, and of the MAA. A probable cause is that instructional practices traditionally have focused only on mathematical content, to the neglect of other "developmental education" factors (e.g. conceptual understanding, cognitive relevance, methods of mathematical learning, etc) entailed in personal mathematical empowerment. Now being assembled is an MAA Special Interest Group (SIGMAA) concerned with applying basic principles of developmental psychology of mathematical learning, for purposes of improving students' success and retention in the core-curriculum. In this presentation, tentative directions for the new "developmental education" SIGMAA will be aired, and input will be sought from teachers of the core-curriculum, arithmetic through calculus.

Speaker: David E. Boliver, University of Central Oklahoma
Title: Fundamentalist Approach to Definitions and Learning Mathematics
Abstract: A fundamentalist approach to definitions will be defined and examples given of how this affects the learning of various mathematical topics at many levels, K-College. This leads to a call for a variety of studies involving the beliefs of students and perhaps teachers about how mathematical definitions are formed and should be presented.

Speaker: Andrew Bucki, Langston University
Title: Six-Pack Functions
Abstract: This presentation is a minor part of my educational program "Less Teaching More Learning" devoted to elementary functions. By means of several functions all functions discussed in Precalculus and Calculus are presented.

Speaker: Charles Mullins, Arkansas School for Math, Sciences and the Arts
Title: Horner's Algorithm
Abstract: Actually there are several algorithms attributed to Horner. One gives a method of determining the coefficients needed to express a polynomial in powers of (x-n) for a given positive integer n. Another one gives a scheme for evaluating a polynomial at a given value of $x = x_0$ and this one can then be used to determine the decimal value of a number given in a different base. The talk focuses on these versions.

Speaker: Thomas Peter, University of Arkansas - Little Rock
Title: A proof of the Power Rule in Calculus by only a Partial Expansion of $(x+h)^n$
Abstract: A proof that $nx^{n-1} = \lim_{h\to 0}\left[\frac{(x+h)^n - x^n}{h}\right]$ is given, where *n* is any positive integer, by showing that $(x+h)^n = x^n + h\left(nx^{n-1}\right) + h^2 g_n(h)$ where $g_n(h) = (n-1)x^{n-2} + (x+h)g_{n-1}(h)$ and $g_1(h) = 0$, $\forall n \geq 2$.

Speaker: Ray Hamlett, Oklahoma Christian University
Title: Higher Degree Polynomial Regression
Abstract: In this paper I use orthogonal polynomials to find the best fitting polynomial of degree *n* to a set of points in the plane, $n \leq 10$. An *F*-test is used to determine the best choice of *n*.

Speaker: Fred Worth, Henderson State University
Title: Baseball as the focus for a general education mathematics course - how it is working
Abstract: In 2005, I presented an outline of a proposed "sports-based" general education mathematics course. It was finally approved and I am teaching it now for the first time. I will discuss what is working, what is not, and some plans for change.

Speaker: Michael Dougherty, Southwestern Oklahoma State University
Title: Using your own textbook drafts to supplement or replace the regular course textbook
Abstract: The author shares some pros and cons of using your own textbook-in-preparation for teaching a course, in his case as a supplement in Calculus 1 and 2, as well as some relevant stories and advice he was given by other authors.

Session: Special Session on the Teaching of Mathematics

Speaker: Danny Arrigo, University of Central Arkansas - Recipient of the 2008 OK-AR Section Distinguished Teaching of Mathematics Award
Title: Undergraduate Research – The Presentation
Abstract: Over the last decade or so, we have seen more and more undergraduates becoming more and more interested in doing research. If fact, at last year's poster session held at the Joint meeting in Washington DC, nearly 300 students were involved presenting posters. A part of a student's research experience is the dissemination of their work. It is important that they are taught how to prepare and present a presentation. In this talk I will discuss some of my experiences is helping students prepare for both poster and oral presentations highlighting some of the "to do's" and "what not to do's" from both the perspective of the student and mentor.

Speaker: Jack L. Jackson II, University of Arkansas – Fort Smith
Title: Using Geometer's Sketchpad to Build Mathematical Reasoning
Abstract: We will investigate the use of Geometer's Sketchpad software to develop mathematical reasoning ability in university students. We will show how this tool can help to make clear the role of examples, inductive reasoning, conjectures, and deductive proof.

Speaker: Clyde Greeno, MALEI Mathematics Institute
Title: Mathematics As Common Sense: Deriving the Basic Trig Functions
Abstract: A PowerPoint presentation that viewers can carry home. The traditional curricular confusions between ratios and quotients enable the traditional, mathematically nice, formal definitions of the six basic trigonometric functions --- which, on students' first encounters with them, preclude conceptual understanding. In a far more constructive development, students are easily guided to personally DERIVE all six "definitions" as personally concluded THEOREMS, directly from the Pythagorean formula. In the process, the usual three Pythagorean theorems are derived as common-sense consequences --- and the (non-quotient) concept of ratios becomes transparent.

Speaker: LeighAnne Locke, Oral Roberts University
Title: Using Writing Assignments to Improve Student Learning in Mathematics
Abstract: Research indicates that using writing assignments in all subject areas is beneficial to student learning. This paper suggests a variety of writing assignments that are linked to course objectives and can help enhance student learning in mathematics courses. Examples of writing to learn assignments will be presented in the context of undergraduate general education mathematics course topics; however, any of the examples could be altered and used for any topic from any subject area.