Abstracts for Contributed Paper Presentations

John Alford
Sam Houston State University

Deterministic Models of Initiation and Propagation of Unidirectional Excitations (Action Potentials) In Excitable Media

Abstract: This talk will present the computations and analysis of some differential equation models which simulate initiation of unidirectional excitations (action potentials) in excitable media. The models depend on a heterogeneous distribution of stimulus and coupling (or diffusion) parameters. In the case of circular spatial domains, unidirectional propagation may result in a rotating wave, which is referred to as re-entrant arrythmia in cardiac tissue. The equilibria and steady-states are computed in order to determine the critical parameter values and ranges over which unidirectional propagation may occur.

Jared Albrecht
Sam Houston State University

The Three Models of Hyperbolic Geometry

Abstract: The Three Models of Hyperbolic Geometry In high school, students are taught planar geometry. As a result, they perceive their surroundings only in a planar sense. However, they will be amazed to know that planar geometry is just one of many. There are three types of geometry, which are Euclidean or planar, hyperbolic and elliptic. In the presentation, the differences and the history of the three geometries will be discussed. We will also talk about the consistency of three models of hyperbolic geometry which are the Poincare, the Poincare Half-Plane and the Klein models.

Kelly Aman
University of Texas at Arlington

Valuations and the Hypergeometric Distribution

Abstract: A valuation is a type of equation used in measure theory and abstract algebra that satisfies the criteria $f(A \cap B) = f(A) + f(B) - f(A \cup B)$. Using valuations, and some of their applications in Geometric Probability, it is possible to derive formulas for the norm, skewness, kurtosis, and etc. of the Hypergeometric Distribution.

Yuliya Babenko
Sam Houston State University

Shape of a bridge

Abstract: Have you ever wondered how engineers come up with a shape for a bridge? Probably no one viewed the Golden Gate Bridge as a mathematical curve and realized that it is the perfect cubic spline (curve made of pieces of cubic polynomials)! In fact there is a reason why you would want every bridge to have the spline shape. This is simply because the cubic spline is exactly the shape that minimizes the potential energy. In this talk, we shall discuss reasons why mathematicians and engineers work with spline functions, some splines nice properties, and give a preview of the Numerical Methods course to be taught at SHSU in Spring of 2008.

Ananda Bandulasiri
Sam Houston State University

Receiver Operating Characteristic (ROC) curves

Abstract: Receiver Operating Characteristic (ROC) curves Receiver Operating Characteristic (ROC) curves are useful for assessing the accuracy of predictions. Area under the ROC curve gives a measurement of the quality of the prediction. In this talk , I will show how to use ROC curves in real world applications. In particular, analysis of sports data using ROC curves will be discussed.

Christa Bauer
Lamar University

Characteristics of a G-Graph

Abstract: Given a group G with generating set S, the $G-$graph of G will contain certain graphical characteristics. I will discuss how specific graph thoerems can be used to determine when a $G-$graph will exhibit characteristics such as a Hamiltonian Path and Planar.

Brian Beavers
Stephen F. Austin State University

See the Constellation: Mathematical Connections

Abstract: One can think of a mathematician as "a person who seeks and finds mathematics where others do not." In this talk we will discuss shoelaces, molecules, Facebook, and other mathematical connections.

Derek Blaylock
Sam Houston State University

Statistical Techniques in Categorical Data Analysis

Abstract: Statistical techniques in categorical data analysis can be used to determine relationships or the dependency among a given set of factors. This presentation will address some statistical techniques in the analysis of 2×2 contingency tables. Recent data from Twenty20 international cricket matches will be used in the analysis. In particular, the impact of home field advantage, toss, and first bat on the outcome of the match will be considered. The analysis will be done using SAS statistical software package.

Kristin Kathleen Creech
Texas A& M University

Dual Dilation Two-Interval Wavelet Sets

Abstract: I will be presenting some results regarding dual-dilation two-interval wavelet sets on the real line. We will review known results involving dilation by two on the left and on the right side of zero. We will also fix one dilation factor while we allow the other one to vary, as well as allowing both to vary. These results are based on the Research Experience for Undergraduates on Matrix Analysis and Wavelet Theory at Texas A&M University.

Terrell Fenner
University of Texas – Tyler

Determining Colorability of Knots

Abstract: Colorability is a knot invariant that gives a simple proof for why the trefoil is not the unknot. The colorability index of a knot K is the collection of numbers n for which the knot K is n-colorable. Prime colorabilities have been found for particular families of knots. We have determined a generalization of this to determine the entire colorability index of any knot based on the crossing matrix of the knot. We use this to show the colorability index of a composite knot depends only on the colorability indices of the prime factor knots used in its decomposition. This theorem answers the open question, does there exist a composite knot which is tricolorable where the prime knots in the decomposition are not tricolorable.

Jillian Hamilton and Andrea DeWitt
Lamar University

Introduction to the $G-$Graph

Abstract: We will explore the concepts of the $G-$Graph. We will explain the definition of $G-$Graph, group, and coset. After these are defined, we will discuss how cosets of a generating set form the vertices of a $G-$Graph and present examples.

Keith Hubbard
Stephen F. Austin State University

Financial Arbitrage: How would you model a costless, riskless investment?

Abstract: The goal of every financial investor is to make a profit with the lowest possible risk and cost. We will discuss how to encode that problem into matrices and then explore how calculus along with a bit of geometry helps us to tackle the problem.

Megan Jennings
Lamar University

The Battle of the Calculus I Sexes

Abstract: The battle of gender is nearly old as our civilization. The gender gap is a very important phenomenon to study. In this study an attempt has been made to see whether there is any significant difference between the male and female students at Lamar as far as their 'general knowledge' concerned. An independent $t-$test has been performed to test the hypothesis.

Mark Lane
Sam Houston State University

Algebraic Combinatorics and Magic $n-$Circles

Abstract: It is known that a one-to-one correspondence exists between the set of all $n \times n$ magic squares and the set of all magic labelings of the complete bipartite graph $f_i(n, n)$ on $2n$ vertices. We give a one-to-one correspondence between the set of all magic $n-$circles and the set of all magic labelings of the complete bipartite multigraph $M(n, n)$ on $2n$ vertices. We discuss the methods used in algebraic combinatorics that allow us to compute the minimal Hilbert basis used to construct any magic $n-$circle with magic sum s.

Alicia Prieto Langarica
University of Texas at Dallas

Learning to Divide

Abstract: The theory of fair division studies ways to split one or several objects between n different people such that all the "players" involved in the partition end up satisfied with their share. Such partitions are called fair divisions. During this talk, we will introduce some of the concepts needed to understand various methods for dividing discrete and continuous objects as well as proofs of the efficiency and fairness of such methods.

Brian Loft
Sam Houston State University
The math behind RSA cryptography

Abstract: RSA cryptography is widely used as a secure way to send and receive data. While virtually impossible to break, the methods used to encrypt and decrypt a message utilize some rather simple mathematics. During this talk, the RSA method will be described, and we'll find out how some of the principles of number theory ensure that this method of cryptography remains secure.

Antonio Lopez
University of Texas at Arlington
The KdV equation: solutions and animations

Abstract: The Korteweg-de Vries (KdV) equation in one spatial dimension is a nonlinear partial differential equation used to model the propagation of surface water waves as well as the propagation of sound waves in a plasma of ionized gas. We analyze a certain class of explicit solutions to the KdV equation, which are generalizations of soliton solutions. Such solutions are uniquely constructed by using three matrices whose entries are real constants, and they can be written in a compact form with the help of matrix exponentials. We express such solutions in terms of trigonometric, exponential, and polynomial functions of the spatial and temporal coordinates. Such expressions become extremely lengthy as the size of the matrices becomes large. We develop a Mathematica program to animate such solutions, analyze their properties, and express them explicitly in terms of trigonometric, exponential, and polynomial functions. The results presented are based on the research performed in the 2007 summer NREUP (National Research Experience for Undergraduates Program) at University of Texas at Arlington supported by the Mathematical Association of America.

Stefanie Meyer
Sam Houston State University
A Complex History

Abstract: We will explore the evolution of the number i. The discovery of the square root of negative one had repercussions on many aspects of mathematics. We will discuss some interesting facts and applications of this fascinating number.

Darren Ong
Texas Christian University
Minimal Surface Symmetries

Abstract: Minimal Surfaces (surfaces with zero mean curvature at every point) are an important field of research within differential geometry. Our research focuses on discovering families of minimal surfaces that are related through continuous deformation. We accomplish this by studying the symmetries of the equations that define minimal surfaces.

Alexis Olson
University of Texas at Arlington

Numerical Solutions to the Coagulation Equation

Abstract: We consider an integral equation describing the coagulation of dust particles. This equation is used to model the formation of Jupiter's moons. We develop a computer program to numerically solve this integral equation using discretization, and we test the accuracy of our numerical procedure through comparisons with the exact analytical solution in some special cases. The research presented was performed as part of NASA's 2007 Undergraduate Student Research Program at the Jet Propulsion Laboratories in Pasadena, CA. Some information about NASA internship opportunities will also be presented.

Mauricio A. Rivas
Sam Houston State University

Morse Theory from a Combinatorial Point of View

Abstract: In this discussion we will give an overview of what Morse Theory is and how it can be used in various aspects of the topology of manifolds. We then discuss a combinatorial version of Morse Theory (as outlined by Robin Forman) and examine how it can affect the topology and geometry of CW-complexes.

Alys Rodriguez
Lamar University

Properties of the $G-$graph of a Group

Abstract: In this presentation, I will describe conditions for which a $G-$graph will have certain graphical characteristics. Examples of this will include but not be limited to circuits, paths, and completeness.

Francisco M. Sanchez
Texas State University-San Marcos

Generating a sequence that satisfies coprime labeling of squared cycles.

Abstract: In this talk we will focus on coprime labeling of squared cycles. In particular, we generate a new sequence of integers, which depends on its independence number, that satisfies the coprime labeling condition and uses the most efficient set of integers. By most efficient we mean that from the set of integers $\{1, 2, 3, \ldots, n, \ldots\}$ we will let the largest label n be as small as possible.

Amanda Seitz
Sam Houston State University

Fun Fibonacci Facts

Abstract: The famous mathematical sequence $1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, \ldots, m, n, m+n, \ldots$, known as the Fibonacci sequence, has been discovered in many places such as nature, art, and music. In this talk, we will discuss the history of the Fibonacci sequence and the man that the Fibonacci sequence was named after, Leonardo Fibonacci. We will also discuss the problem solved by Leonardo Fibonacci that made this sequence famous, the golden ratio and how it involves Fibonacci numbers, the occurrence of the Fibonacci numbers in nature, and equiqangular spirals. Finally, we will discuss some of the mathematics behind the sequence and other neat properties of the Fibonacci sequence.

Sara Jayne Slocombe
Louisiana State University Shreveport

Mathematics Behind Basic Enhancements of Digital Images

Abstract: We will start by learning how a computer understands digital images. This talk will focus on the mathematics that control some basic enhancements of digital images to include cropping, adjusting brightness, and changing contrast, primarily based on simple matrix multiplication.

Ken Smith
Sam Houston State University

Three Undergraduate Research Problems in Graph Theory

Abstract: We describe three undergraduate research problems accessible to sophomore math majors. All three problems begin in graph theory but lead to complicated phenomena that require experimentation and creativity. In the first project, we introduce the concept of a "randomly decomposable graph." In the second project, we examine the "summability number" of a graph. Finally we study the "relative gain array" function on the adjacency matrix of a graph. With each project I will share the little bit that I know...and will quit when the problems become hard!

Laura Strube
University of Texas – Tyler

Searching for Extensions

Abstract: The Second Cohomology group of Q and K will be introduced as a group isomorphic to the group of all extensions of K by Q. Its development will be described using the basic concepts of group theory such as the definitions of groups, subgroups, and morphisms. In addition, we will discuss the challenge of finding all extensions of K by Q.

Ashley Weatherwax
University of Texas – Dallas

Fun with LC-loops and Quasigroups

Abstract: A quasigroup is a group-like algebraic structure consisting of a set with a binary operation and inverses. Quasigroups possessing a neutral element are called loops. A loop is called an LC-loop if it satisfies the weak associative property $xx \cdot yz = (x \cdot xy)z$, for all x, y and z. This identity is equivalent, in loops, to each of the following three identities: $x(x \cdot yz) = (x \cdot xy)z$, $x(x \cdot yz) = (xx \cdot y)z$ and $x(y \cdot yz) = (x \cdot yy)z$. In quasigroups, each of those four identities defines a different variety of quasigroup, namely the LC1, LC2, LC3 and LC4-quasigroups, repectively. This research investigates which properties can be given to LC-quasigroups to give them an identity, as well as explores the structure of certain subsets of LC-quasigroups.

Dana Wheaton
Sam Houston State University

Billiard Mathematics

Abstract: During this talk, we will conduct a geometric look into billiards. We will study the angles required for shots and where error can occur. This examination will include not only error gotten from the table, but from the ball and cue as well.

Krystal Woods
Sam Houston State University

How Long is the Coast of Britain?

Abstract: This presentation will analyze one of the questions that led to the rise of fractal geometry by introducing to the audience the mathematics of fractals and the definition of fractal dimension. We shall discuss what a fractal is and how it pertains to nature while simultaneously giving a brief description of Benoit B. Mandelbrot's work. It will cover two specific fractal examples, the Koch curve and the Cantor set fractal, and give the mathematic explanations of both. It will also explain the difference between Euclidean and fractal dimension with the mathematical development of the latter. The presentation will then be concluded with ways to solve the question of the length of Britain and more examples of other fractals.