Spring 2014 80th Series

M*A*T*H COLLOQUIUM

Wednesdays 4 p.m ❖ Darwin 103 ❖ Coffee, Tea & Cookies @ 3:45 p.m.

Sonoma State University Department of Mathematics and Statistics presents a series of informal talks open to the public.

"Mathematics is the process of turning coffee into theorems" Paul Erdös

Jan 22 **Numerical Approximations with the Sinc Function** — **Chad Griffith, Harmony Farm Supply and Sonoma State University**

The sinc function or "sampling function" is used often in signal processing and in Fourier transform theory. Numerical methods usingthe sinc function have been shown to be very accurate in approximating functions near singularities. We will explore some commonalgorithms from Numerical Analysis to help us build a sinc collocation method. We will then show how this can be used to approximate an integral with a singularity in its region of integration.

Jan 29 **Shapes of spaces: 2- and 3-manifolds** — **Marion Campis, Stanford University**

While we do not know what the actual shape of the universe is, mathematicians have been able to determine possible shapes a 3-dimensional universe could have. Before we try to understand these shapes, called 3-manifolds, we will build our intuition by considering the perspective of beings living in 2-dimensional universes, or 2-manifolds. We will consider possible 2-manifolds and develop tools that a being living in such a space could use to distinguish them. Finally, we will develop a picture of several different 3-manifolds and consider if there is any way to know whether any of them might be the shape of our own universe.

Feb 5 **Be Part of a San Francisco Math Circle (If Only For Today)** — **Hannah Winkler, San Francisco State University**

We will introduce the San Francisco Math Circle, an after-school mathematics enrichment program designed to increase the quality and quantity of students who enter the field of mathematics professionally, or who simply love to work with mathematics in their daily lives. This is most often done through fun and engaging activities, not necessarily related to any curriculum. You will be provided with a chance to learn more about the program through the types of activities I led, and experiences I had, as an instructor at three middle and high schools in San Francisco.

Feb 12 **A Mathematical Description of Endothelial cells and Some Related Eigenvalue Problems** — **Bori Mazzag, Humboldt State University**

The talk will summarize some previous projects I have done with HSU students on developing a simple model for cells lining the blood vessels, called endothelial cells. When these cells are represented as a network of viscoelastic bodies, we can solve a system of linear differential equations to find deformation of cell components in response to an applied force. The matrix representation of these equations have some very interesting structure. I will pose (and partially answer) some questions about the eigenvalues of these matrices.

Feb 19 **Groupoids and Egyptian Fractions** — **Julie Bergner, University of California Riverside**

Given a group, we can take its order by counting the number of elements. Furthermore, given any natural number, we can find a group of that order. One way to generalize groups is by a structure called a groupoid. There is a fancier way to "count" a groupoid which results in a positive real number. We could then ask if we can get any positive real number from a groupoid in this way. This question turns out to be equivalent to an old question in number theory of whether any positive rational number has an Egyptian fraction decomposition, and the answer to both is yes. In this talk, we will introduce groupoids and their cardinality, as well as Egyptian fractions, and give a proof establishing the positive answer to the above question.

Feb 26 **Did I Trap the Median? A Lesson Plan on Confidence Intervals for High School Students** — **Rafael Diaz, Sacramento State University**

Point estimates of population parameters are considered no better than educated guesses if they are not estimated with a confidence interval. Traditional teaching of confidence intervals requires that students first learn concepts of theoretical probability distributions and the Central Limit Theorem. This lesson plan presents an intuitive approach to teaching the concepts of confidence intervals through Monte Carlo simulations. This approach constructs non-parametric confidence intervals for a population median using sample quartiles. Although these confidence intervals do not have the optimal features of parametric confidence intervals, they do illustrate intuitively how the reliability of confidence intervals is obtained. [The freely available online statistical software "SeeIt" used in this lesson plan also allows for the teaching of the influence of sample size and shape of population distributions on both the reliability and width of confidence intervals. Suggestions are also presented to extend the material of the lesson plan to teach the construction of more accurate (shorter) confidence intervals by using the sample size as a scale factor.]

Mar 5 **Cryptography and Codes: A Brief History of Encryption and Its Uses** — **Dean Gooch, Santa Rosa Junior College**

What is cryptography? What influences has cryptography had on world history? Has and is cryptography used for the purposes of espionage? Has cryptography ever been the determining factor in the winning of battles or wars? What is recreational cryptography and who does this? How does cryptography effect one's life in today's society? These are the questions that will be addressed in this brief talk on cryptography.

Mar 12 **What Should We Teach in Our Intro Stat classes?** — **Brian Jersky, Cal Poly Pomona**

Here's a possibly interesting thought experiment: if you were designing a syllabus for a new class, called "Introduction to Statistics", and you had no preconceptions about what should be in it, or where the subject came from, what would you end up teaching in the class? In this talk, statistician, former professor at Sonoma State and current dean of the College of Science at Cal Poly Pomona, Brian Jersky, will talk about what an Intro Stat class might look like as a result of this hypothetical experiment. He believes such a class would be very different in some ways from what we currently do teach, though quite similar in others. The material in the talk will be accessible to anyone.

Mar 19 **No Talk—Spring Break**

Mar 26 **The Joy of Mathematica** — **Math 180 Students, Sonoma State University**

You thought Mathematica could only take derivatives and integrate? Come see the amazing student projects from Nick Dowdall's Fall 2013 Mathematica class, Math 180

Apr 2 **Fun with Deterministic Finite Automata** — **David Lofte, Foothill College**

A Deterministic Finite Automata (DFA) is a simple computing machine that reads a string of symbols; the DFA then accepts or rejects the string. In this talk, we will get hands-on with DFAs and discover that although they are extremely powerful and can accept a fairly robust language (set of strings), there are strings that these machines cannot parse. The humble DFA is the first step on the road to discovering what it is possible in computation.

Apr 9 **Hands On Math: "What good is this?"** — **Ann Herbst, Santa Rosa Junior College (Emeritus)**

Presentation of examples from the fields of construction, finance, health and art that use high school/first year college mathematics. Questions to be answered include: "how does a California city set speed limits?"; "how (and why) does a British Church ring bell patterns?"; and "what does a recent PG&E bill tell you about your energy usage?" Mathematical topics come from calculus, statistics and mathematics appreciation courses.

Apr 16 **[MATH FESTIVAL] Art Inspired by Science and Mathematics** — **Carlo Sequin, University of California Berkeley**

What came first – art or science? How do science and mathematics inspire art? How can math and computers be used to create new artwork? Might the "11-Cell" be a building block for our 10-dimensional universe? These questions will be discussed in this talk, and the design and construction of some related artwork will be described.

Apr 23 **Towards Jet Acoustic Prediction Within the Launch Ascent and Vehicle Aerodynamics Framework** — **Jeff Houseman, NASA**

Understanding the acoustic environment generated during lift-off is critical for successfully designing new space vehicles. In order for modeling and simulation tools to effectively assist in the development of the vehicles, validation must be performed on simplified problems. In this paper, time-accurate implicit large eddy and detached eddy simulations coupled with a linear acoustic propagation method are applied to a Mach 1.8 perfectly expanded jet impinging on a flat plate at 45 degrees. The Launch Ascent and Vehicle Aerodynamics (LAVA) code used to simulate this problem is a high-fidelity unsteady simulation tool for modeling fluid dynamics, conjugate heat transfer, and acoustics. A detailed description of the linear acoustic propagation tool is presented. The narrow band far-field Power Spectral Densities (PSDs) and Overall Sound Pressure Level (OASPL) predicted using LAVA are compared to existing experimental data. Sensitivity of the predicted far-field sound pressure levels to position of the acoustic propagation surface is also assessed.

SONOMA STATE UNIVERSITY

DEPARTMENT OF MATHEMATICS AND STATISTICS

❖ Phone: (707) 664-2368 ❖ Fax: (707) 664-3535 ❖ www.sonoma.edu/math ❖

Series supported by Instructionally-Related Activities Funds

Talks may change: Please confirm with the Department of Mathematics and Statistics