Spring 2016 84th 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

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Feb 3 — **Mathematical Modeling as a Habit of Mind** — **Brigitte Lahme, Sonoma State University and Krista McAtee, Sonoma Valley School District**

For many people, mathematics means performing procedures fluently to "get the right answer." How do you go from this view of mathematics instruction to a culture where students regularly engage in mathematical modeling from Kindergarten to graduate school? Engaging in mathematical modeling can seem overwhelming especially if we view modeling problems only as huge open-ended projects. So how do students learn to engage in mathematical modeling in a way that it will become a mathematical habit of mind? In this talk we will look at examples of mathematical modeling in high school and college courses and discuss the evolution of mathematics instruction.

Feb 10 — **Mathematical Ecology of Climate Change and Invasive Species** — **Robin Decker, University of California Davis**

Mathematical ecologists use models to understand and predict changes in the distribution and abundance of life. Integrodifference equations are recurrence relations that can be used to model the continuous distribution of individuals over generations. I will show how integrodifference equations can be used to help us understand two different, urgent ecological problems: 1) How will climate change transform the current distributions of plants? 2) How do we predict the rate of spread of invasive species, and which invader traits accelerate the spread?

Feb 17 — **Pathway Association: Finding a Group of Related Genes that are Jointly Associated with a Trait of Interest** — **Tao He, San Francisco State University**

Single variant analysis in genome-wide association studies (GWAS) has been proven to be successful in identifying thousands of genetic variants associated with hundreds of complex traits. However, these identified variants only explain a small fraction of inheritable variability in many traits. As a remedy, set-based methods were proposed and hold great promising because the genetic variants tend to work together to achieve certain biological function. In this work, we combine a high-dimensional of genetic variants that belong to a biological pathway to form an integrated signal aimed to identify pathways that are associated with the trait.

Feb 24 — **The Joy of Mathematica: Student Projects from the Fall 2015 Math 180 Class** — **Martha Shott and Grace Brown, Sonoma State University**

You thought Mathematica could only take derivatives and integrate? Come see some amazing student projects — card games, population management, and forensic investigation — from Grace Brown and Martha Shott's Fall 2015 Mathematica class.

Mar 2 — **Being (slightly) Flippant about Flipping** — **Steven Pon, University of California Davis**

In recent years, the idea of a "flipped" classroom has been promoted as a cure for what ails many modern mathematics classrooms. But does the method deliver on its promise? We'll try to cut through the hype and take a look at research on the effectiveness of the classroom-flipping approach in college mathematics.

Mar 9 — **Models, Models, Everywhere: Student Projects from the Fall 2015 Math 470 Class** — **Martha Shott, Sonoma State University**

We all know and love differential equations, matrices, and regression analysis, but how do they apply to the world outside of the mathematics classroom? Get a glimpse at the variety of possibilities through projects by the Fall Mathematical and Statistical Modeling students.

Mar 16 — **No Talk—Spring Break**

Mar 23 — **Sperm Motility in Populations** — **Julie Simons, California Maritime Academy**

As sperm travel towards the egg, they use a primarily planar flagellar waveform to swim. During this process, they must effectively navigate a highly complex environment that includes interactions with surfaces and nearby neighbors. We will discuss mathematical modeling approaches to understand this process in a fully three-dimensional context. This model will enable us to understand experimentally-observed motility patterns and postulate on the importance of waveforms, swimming in populations, and the complexity of the fluid environment.

Mar 30 — **Algorithms for Logarithms** — **Sam Brannen and George Ledin, Sonoma State University**

The number of elementary arithmetic operations is small. Addition and multiplication, and their inverses, subtraction and division, are familiar to all primary school children. The simplest operation, counting, is learned in pre-school. Exponentiation is usually introduced in middle school, and its two "inverses" – root extraction and logarithmication, are postponed till the last year of secondary school or relegated for remediation in college. Yet knowledge of exponentiation, root extraction, and logarithmication is essential to all science majors. We explore the idea from the point of view of logarithms; to celebrate the 400th anniversary of their invention by John Napier in 1614 and because logarithms pervade theoretical computer science, where discrete logarithms require much attention.

Apr 6 — **The Transit of Venus** — **Jim Pedgrift, Sonoma State University**

The Transits of Venus which took place in 1761 and 1769 were the first opportunities for the scientific community to establish a reliable estimate for the size of the solar system. The concept of the calculation is rather subtle but the actual mathematics involved is accessible to any SSU math student. Retired SSU math lecturer, Jim Pedgrift will walk us thru the history and the trigonometry of the historic event.

Apr 13 — **An Algebraic Approach to Analyzing NBA Teams** — **Steven Devlin, University of San Francisco**

An important but hard problem in basketball analytics is how to quantify contributions to team success. Some contributions are important but subtle (movement without the ball, screens, passing). Furthermore, anything that happens in a basketball game does so in the context of five teammates sharing the court. This introduces a kind of co-dependence among observations-- to what extent is my team's success when I play really due to me, and not the teammates I play alongside? In this talk we use ideas from linear and abstract algebra, specifically representation theory, that are particularly well suited to answering these types of questions, and more. We'll give a full analysis of some NBA teams by applying these techniques to actual NBA play-by-play data.

Apr 20 — **[MATH FESTIVAL] Math is Power not Punishment** — **Dan Meyer, Desmos**

We often offer students shortcuts, strategies, and skills before students understand their origin, their value, and the millions of hours of work they've saved mathematicians throughout history. We'll look at techniques for putting students in a position to need these challenging skills so they feel like power, not punishment.

Apr 27 — **Benford's Law** — **Ken Ross, University of Oregon, Emeritus**

Often data in the real world have the property that the first digit is 1 about 30% of the time, the first digit is 2 about 17% of the time, and so on with the first digit being 9 about 5% of the time. This phenomenon is known as Benford's law. I will begin with a simple explanation, suitable for nonmathematicians, of why Benford's law holds for data that has been growing (or shrinking) exponentially over time. Several examples and results will be discussed.

May 4 — **Mathematical Modeling of Prion Dynamics in Yeast** — **Suzanne Sindi, University of California Merced**

Understanding complex biological processes often requires collaborations between mathematical and biological scientists. In this lecture, I will share some recent work in modeling prion diseases. Unlike a disease caused by a virus or a bacteria, in prion diseases the infectious agent is created by the host organism itself. Prion proteins are responsible for a variety of neurodegenerative diseases in mammals such as Creutzfeldt-Jakob disease in humans and "mad-cow disease" (Bovine Spongiform Encephalopathy or BSE) in cattle. While these diseases are fatal to mammals, prions are harmful to yeast, making yeast an ideal model organism for prion diseases.

The common formulation for prion dynamics is the Nucleated Polymerization Model (NPM) given either in the form of a PDE or infinite system of ODEs. I will present an improved model for prion dynamics in yeast that we call the Enzyme-Limited Nucleated Polymerization Model. We first validate our model through comparisons with biological experiments and then discuss implications for prion biology. Finally, prion proteins within yeast cells present many intriguing behaviors highly amenable to mathematical modeling and I will close by discussing on-going and future work.

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