M*A*T*H

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

"The first thing to understand is that mathematics is an art." -Paul Lockhart

Every Wednesday at 4:00pm in Darwin 103. Coffee, Tea & Cookies at 3:45pm in Darwin 103.

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

Series supported by Instructionally-Related Activities Funds

August 28

The Role of Individual Cell Behavior in Prion Diseases — **Mikahl Banwarth-Kuhn, UC Merced**

Prion proteins are most commonly associated with fatal neurodegenerative diseases that occur in mammals, such as Mad Cow Disease. The term "prion" refers to abnormally shaped, disease causing agents that recruit other normally shaped proteins to misfold and accumulate into clusters. Mathematical models have been an essential tool in studying prion and other protein misfolding and clustering processes. While the majority of mathematical models have been developed for studying prion diseases without considering individual cell behavior, a major open question in prion biology is to understand how prion clusters spread between cells within a whole colony or tissue. In this talk, we introduce two different types of models, an ordinary dierential equation (ODE) model used to keep track of the number and sizes of prion clusters over time, and an agent-based model used to simulate the behavior of a large number of cells growing and dividing within a colony or tissue.

September 4

Using Statistics to Accelerate Clinical Drug Development in Oncology — **Houston Gilbert, PhD, Bellicum Pharmaceuticals**

Investigational products in oncology have traditionally been developed and approved by progressing through three sequential phases of drug development: Phase 1 (safety and dose finding), Phase 2 (proof of concept) and Phase 3 (confirmation of benefit). With better anti-cancer agents being developed and with greater openness and flexibility among global regulators, the lines between the phases of drug development are blurring more than ever before. Good statistical practice, however, is still required in order to generate and analyze data which allow us to get safe and effective treatments to increasingly narrower and targeted groups of patients sooner. In this context, with the goals of the classical phases of drug development in mind, applied statisticians can help transform the discussion into one of learning versus confirming, and hypothesis generation versus hypothesis validation.

September 11

Using Nonparametric Statistics to Understand Our Changing Climate and the Water Cycle — **Robin Glas, SSU**

To better understand the effects of climate change on streamflow, stream and river response, both temperature and precipitation needs to be examined at scales that highlight regional changes in water resources. Abrupt changes in streamflow volume, or "change points", were identified. These change points occurred in clusters both spatially and by low, medium, and high flows. Spatial clustering, Mann-Kendall trend tests, and the Sen-Thiel slope analysis were performed across all sites, as well as other non-parametric statistical methods. Results highlight trends toward wetter Januarys, as well as linkages between seasonal precipitation and annual streamflow. These statistical methods are ideal for working with streamflow and precipitation values, which follow non-normal distributions in nature.

September 18

Different Definitions of Differential Equation Solutions — **Khalialah Beal, UC Berkeley**

What is a solution of a differential equation? It depends on the context and in this talk we'll investigate the concept. We will consider both different definitions and motivations for having different definitions. If time permits, we will introduce integral equations, too.

September 25

What Even Are Fractals? — **Andrea Arauza Rivera, CSUEB**

We will begin with a "you know it when you see it" introduction to fractal sets. For many years mathematicians avoided working with fractals and referred to them as the "monsters" of mathematics. Recently, however, mathematicians have begun to explore fractals, as they can be used to describe the chaotic nature of the real world. We will embark on a historical journey where we'll meet important mathematicians who study fractal sets and on the way we will explore some of the basic properties that make fractals so monstrous.

October 2

Designing for Belonging — **Dan Meyer, DESMO**

Researchers have linked a student's feeling of "belonging" in math class to positive outcomes in mathematics, including their confidence and intent to pursue math in the future. We'll discuss reasons why students often feel excluded from learning mathematics, along with modern pedagogies, technologies, and designs for including them.

October 9

Euclid and Euler: The Evolution of Number Theory — **Phil Kutzko, University of Iowa/Math Alliance**

When we who are working mathematicians carry out our duty of explaining mathematics to our students, we often forget how important it is to explain the way in which mathematicians think. This is by no means an entirely scientific matter and, in fact, there is a big cultural component to how we think about mathematics. If we neglect to discuss this component, we deprive our students of the "secrets" of our profession and then they must discover those secrets by themselves. And this is especially true if our students come from backgrounds where they have had little exposure to the dominant scientific culture and way of thinking. We will look at the question of whether or not there is an infinite number of prime numbers first from the point of view of Euclid and then from the much more technical and culturally specific point of view of Euler.

October 16

Collegiate Mathematics Education Research Sampler — **Shandy Hauk, SFSU**

This session is a sampler across four studies. First, are results of a recent examination of Khan Academy use in community college algebra. Then come preliminary findings from a study on flipped approaches to teaching calculus at institutions in the Cal State system. Early results from a third study, on a mini-course for faculty who teach future K-8 teachers, indicate there are special kinds of mathematical and cross-cultural knowledge needed for teaching future teachers. Finally, the colloquium will dig deeply into a fourth area: how to build attention to equity and instructional responsiveness into mathematics graduate student preparation.

October 23

What Does Math Look Like Through a Social Justice Lens? — **Kim Seashore, SFSU**

This talk, drawing on the work of Bill Tate, Eric Gutstein, and Cathy O'Neal, will discuss how math is intertwined with advancement of social justice in several different ways: How math is taught, how access to math education is granted and the access that math education provides to other fields, and how math can be used to either foster inequity or promote justice. We will do tasks that are both fun and highlight the ways that math can promote an equity agenda.

October 30

An Abundant Exploration — **Nick Dowdall, SSU**

What are abundant, deficient and perfect numbers and how do they behave? We will explore the abundance function and its mapping from N-->Z in the undergraduate-accessible talk.

November 6

Using Evolutionary Game Theory to Understand the Challenges to Cooperation (& their possible solutions) — **Christina Moya, UC Davis**

Humans cooperate with others on a daily basis; we care for family when they are ill, we take turns paying for meals with friends, and we give money to strangers in need. This behavior seems so natural to us that we might not bother asking why we engage in such behavior, and why it's so much rarer in other species. Biologists use evolutionary game theory to develop mathematical models that help us think through why such behavior is puzzling, why it happens nonetheless, and the conditions when it is likely to arise. We will work through some basic evolutionary game theory models of cooperation to help us understand some of the challenges we face in fostering cooperation in societies, and some of the possible solutions.

November 13

Microbes, Their Genes, and Us; Statistics for a Better World — **Aram Avila-Herrera, Lawrence Livermore Labs**

There are many interesting questions about how ourselves, our microbes, and the molecules of life are associated, some of which may highlight symbiotic relationships with important global impact. We'll explore some of these questions by translating them into math problems that hopefully computers can solve.

November 20

Uncovering the Hidden World Beneath the Antarctic Ice Sheet — **Noemi Petra, UC Merced**

I will discuss the Applied Mathematics graduate program at the University of California, Merced during the first half of the talk. In the second half of the talk, I will discuss my work applying numerical analysis, linear algebra and optimization, to the dynamics of the Antarctic ice sheet. Ice sheet flow models contain unknown parameters, due either to our inability to directly observe them, or their role as phenomenological parameters that must be constrained by data. I will present an inversion technique that allows us to solve very large-scale problems, such as the Antarctic ice sheet problem. This research will help climate scientists better understand the flow of Antarctic ice from the continent into the sea and its effect on the sea level rise.

COLLOQUIUM