M*A*T*H COLLOQUIUM

Spring 2023 98th Series

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

"The book of nature is written in the language of mathematics" - Galileo

Live & on Zoom ~ Wednesdays at 4:00pm

https://bit.ly/SSU-Math-Colloq-S23

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

Series supported by Instructionally-Related Activities Funds

Feb 1

An Invitation to Enumerative Geometric Combinatorics — **Andrés Vindas Meléndez , UC Berkeley**

Enumerative geometric combinatorics is an area of mathematics concerned with counting properties of geometric objects described by a finite set of building blocks. Lattice polytopes are geometric objects that can be formed by taking the convex hull of finitely many integral points. In this talk I will present background on polytopes and lattice-point enumeration, and share some results on a special family of polytopes that can be further studied. Throughout the talk I will present questions and open problems. (No prior knowledge will be assumed, and I will attempt to explain all concepts.)

Feb 8

Measuring to the Stars: The Apotheosis of Trig — **Rick Luttmann, Sonoma State University Professor Emeritus**

From the Earth we cannot measure distances to heavenly bodies directly. However, we can measure angles and time, and with a sextant and a clock as our only tools (and some occasional physics) we can work our way up — beginning with the size of the Earth; then the sizes and distances of the moon, sun, and other planets; then the distances of nearby stars, and then other stars in our galaxy; finally the distances of remote galaxies. (Along the way we infer the speed of light.) Most of our calculations are done using nothing deeper than elementary trigonometry.

Feb 15 (from Mar 15)

Sudoku and Set Theory — **Nick Franceschine, Actuary and retired Sonoma State University lecturer**

Sudoku puzzles give challenge and entertainment to millions of people. In recent years, people have used mathematical set theory to prove interesting theorems and solve puzzles. In this talk, we'll explore some of the ways that Set Theory is being used to solve Sudoku puzzles.

Feb 22

The Statistical Selection of Stocks and Opportunities to Get Involved in Statistics — **Luella Fu, San Francisco State University**

In this talk, we will look at some different ways for interested students to get involved with statistics and data analysis, as well as sharing my career path. As part of this, I will introduce SFSU's Master's in Statistical Data Science program and the DataJam project based out of the University of Pittsburgh. I will also share some research I do on the ranking and selection of comparable units, useful for choosing stocks based on historical performance or picking restaurants based on reviews.

Mar 1

The Joy of Statistical Consulting, Mathematical Research, Programming, and Modeling! — **Students from Math 180, 467 and 470**

As Sonoma State students progress through their math and stats courses, they become more aware of the connections across coursework, the power of using technology effectively, and the variety of applications that mathematics and statistics have in their future lives. Come see some amazing student projects that combine mathematical expertise with student creativity in a selection of our courses.

Mar 8

Electric Power and Complex Numbers: Imaginary Axis to the Rescue! — **Sascha von Meier, Independent Consultant**

This talk will introduce complex numbers as a tool for the analysis of electric grids. Mathematically, alternating voltage and current from the wall outlet looks ap-proximately like a sine or cosine — but with some important caveats. We will encounter Euler's formula, phasors, and techniques for manipulating quantities like electric power transfer with convenient shortcuts. We'll also highlight some of the surprises that can occur when the physical world doesn't quite match the idealized mathematical model.

Mar 15 (moved from Feb 15)

A Data-Driven Approach to Prediction and Management in Ecology — **Bethany Johnson, UC Santa Cruz**

Humans depend on natural ecosystems on a global scale, so it is important to establish robust methods for management in ecology. We will explore one example of a space where reliable management is needed: insect pest control. Some insect species pose a threat to humans by jeopardizing food security in agricultural systems, acting as vectors for infectious diseases, and damaging forests and other ecosystems. Despite decades of research, effective management remains challenging. Incomplete knowledge of the mechanisms that drive population dynamics makes it difficult to develop accurate models for outbreaks, so control actions are often applied once outbreaks have already begun—too late to prevent significant damage. We will see how a data-driven approach called empirical dynamic modeling can effectively predict outbreaks, circumventing the need to understand the underlying ecosystem dynamics, and how optimal control theory can be used with the data-driven model to keep insect populations within acceptable bounds of tolerance. Finally, we will explore applications to ecosystems beyond insects.

Mar 22

No Talk ~ Spring Break

Mar 29

Book Embeddings of Graphs — **Shannon Overbay, Gonzaga University**

In the classical *book embedding problem*, an n-page book is formed by connecting n half-planes (the pages) together at a common line (the spine) in 3-space. To embed a graph in a book, we place the vertices of the graph on the spine and the edges of the graph on the pages of the book so that no two edges cross each other or the spine. The book thickness of a graph is the smallest n for which the graph admits an n-book embedding. We will examine some classical book embedding results, including edge bounds and characterizations of one and two-page embeddable graphs. We will also look at some new generalizations of books by modifying the pages and show how these relate to various data structures and delivery systems. Bring a pencil and paper to discover some facts about book embeddings for yourself!

Apr 5

Make Math REAL: Learning Math by Creating
Ben Ford, (Math & Stats) and Kathy Morris, (Math Education, Emerita), Sonoma State University

How can robots, art, slime, and arcade games lead to deep learning of important mathematics? Many students experience school math as disconnected from things they care or wonder about—can we help them instead learn math as a set of lenses to understand things that matter? We'll give examples of fourth- and fifth-grade curriculum projects we're designing and testing through an NSF-funded project, in which students learn about volume with their robots, fractions and scaling with their slime, and much more.

Apr 12

Linear Algebra and Color Vision — **Steve Trettel, University of San Francisco**

The subjectivity of color perception has fascinated both children and philosophers since antiquity. Indeed, I recall as a child asking myself "*do I see 'red' the same as my friend*?" and "*do television shows look true-color to my dog?*" Perhaps surprisingly, while these may seem equally philosophical and unanswerable, the second is actually a precise mathematical question in disguise! In this talk, we will analyze color vision mathematically, and use the power of linear algebra to answer questions such as "*why are there three primary colors?*", "*why do we see 6 colors in a rainbow, but birds see 14?*" and of course, "*what does a television set look like to a dog?*"

Apr 19

Using Mathematics to Try to Understand Information—a Story From the Early Days of the World Wide Web
Keith Devlin, Stanford University Emeritus; Mathematician in Residence, Sonoma State University

With the growth of the Internet in the 1980s (the Web was launched in 1991, Google was still ten years in the future), researchers were trying to come to grips with the concept of "information." Though the term "information technology" had been introduced back in 1958, there was no agreed definition of "information", and no formal theories to guide development of those new technologies. In 1987, I was invited to join a large, multi-disciplinary research group at Stanford University that was created in 1983 to try to develop a mathematically-grounded theory of information. (Perhaps something akin to physics, which provides a mathematically-grounded basis for engineering, or chemistry and biology that support health care and medicine.) The project provides a good illustration of the way mathematics can be developed and used to understand, and act in, a changing world.

Apr 26 Math FEST

Modeling the Evolution of Coronaviruses Using Mathematics and Machine Learning
Javier Arsuaga, Departments of Mathematics and Molecular & Cellular Biology, UC Davis

The COVID-19 pandemic has shown the importance of developing models that can predict whether a (non-human) animal virus can spill over to humans and how a virus will evolve once it is spreading among humans. In coronaviruses a key step in the infection process is the binding of the viral spike (S) protein to the human receptor. In this talk, I will present mathematical and machine learning models that use the sequence and structure of the S protein to predict the spread of coronaviruses.

May 3

An Analog of Traditional Calculus As We Know It — **Ariel Setniker, California State University Maritime Academy**

The derivative is at the heart of mathematics and specifically calculus, so why not extend this idea? *What does it mean to take a half derivative? A πth derivative?* These are the questions that sparked the area of fractional calculus. In this talk, we will investigate these intriguing questions and draw comparisons between traditional calculus and fractional calculus. Time permitting, we will explore some of the various applications for which fractional calculus is well-suited.

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

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