M*A*T*H COLLOQUIUM

Fall 2024 101st LECTURE SERIES

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

WEDNESDAYS at 4PM In Person: DARWIN HALL 103 Virtual: https://bit.ly/MathColloquiumFall2024

8/28/24 **Chan Ross Endowed Talk on Pure Mathematics, A Personal Glimpse of the Life and Contributions of the Great Geometer S. S. Chern with Jean Bee Chan, Professor Emerita, Sonoma State University**

Professor Chan will tell personal stories of S. S. Chern, and give an introdution to curves and surfaces leading to an overview of Chern's contributions to differential geometry.

9/4/24 **Identifiability: Using Math and Trees to Solve Problems from Biology** **Cash Bortner, Stanislaus State University**

Recovering parameter values from mathematical models is a primary interest of those that use them to model the physical and biological world. This recovery, or identification, of parameters within models is also an interesting mathematical problem that we call Identifiability. In this talk, we will explore the identifiability of a specific type of model called Linear Compartmental Models, which are often used to understand biological phenomena and have an underlying graphical structure. Starting with an introduction to graph theory, we will explore the relationship that this graphical structure has to Linear Compartmental Models and their defining differential equations. At the end of the talk, we classify identifiability criteria for an interesting subclass of Linear Compartmental Models called tree models.

9/11/24 **Reproductive Implications of Swimming in 3D** **Julie Simons, UC Santa Cruz**

The motion of thin structures like cilia and flagella is vital for many biological systems. In this talk, we will use reproduction and sperm motility as a primary motivator for studying the motion of flagella in 3D fluid environments. Mathematically, we can model a flagellum as a curve in space and approximate the fluid environment as a Stokesian, inertialess world. Many models for flagellar motion in such settings have been developed over the span of many decades, starting with early works using 2D approximations. More recent advancements--technologically, mathematically and computationally--have allowed for exploration of motion in fully three-dimensional contexts and some surprising results. We will describe the mathematical framework for recent work involving the Method of Regularized Stokeslets and preferred curvature and then present results involving individual swimmers near surfaces, groups of swimmers, and cooperative swimmers. We hypothesize that some species of animals have developed cellular structures that enable sperm to swim faster and more efficiently, perhaps in response to sperm competition due to mating behavior.

9/18/24 **Presentation from Students of Cryptography** **Math 495 Cryptography, Sonoma State University**

We will hear results from student projects, directed by Dr. Izabela Kanaana, in various topics in cryptography.

9/25/24 **Antidotes to Math Supremacy** **Katrin Wehrheim, UC Berkeley**

Drawing on work from Tema Okun and Rochelle Gutierrez, among others, as well as anecdotes from my own math & life experiences, I'll offer a notion of "math supremacy culture" as a reflective tool to help us see more clearly when (traditional) math culture gets in the way of justice. I'll then invite us to use this lens to envision the culture we want, need, and deserve -- and identify direct actions that each of us can take towards it.

10/2/24 **My Mathematics Story** **Keisha Cook, Clemson University** *****via Zoom**

Keisha Cook is an Assistant Professor in the School of Mathematical and Statistical Sciences at Clemson University. Her research is in Applied and Statistical Sciences at Clemson University; e.g. stochastic processes and single particle tracking. Dr. Cook collaborates with experimentalists to develop mathematical models and methodologies to statistically analyze the transport of points in space over time. Her interdisciplinary research includes fields of bioengineering, material science, physics, and forestry. In addition to research, she teaches courses in probability and stochastic processes. In this talk she will talk about her journey through mathematics, her many research projects, and the organizations and programs that she has been a part of that strive to support and mentor underrepresented minorities in mathematics.

10/9/24 **The Beauty of Halving it All** **Cornelia Van Cott, University of San Francisco**

We start with a simple challenge. Draw a shape, and then find all straight lines that slice the shape in half. The challenge is simple, yet it quickly yields beautiful pictures, mathematical results, and new questions. Come and see!

10/16/24 **Bounds and Bugs: The Limits of Symmetry Metrics to Detect Partisan Gerrymandering** **Ellen Veomett, University of San Francisco**

In recent years, a wide variety of techniques and metrics have been proposed as measures to detect when a map is a partisan gerrymander. The most accessible measures, requiring easily accessible data, are metrics such as the Efficiency Gap, GEO metric, Mean-Median Difference, Partisan Bias, and Declination. But for most of these metrics, researchers have struggled to describe how the value of that metric on a single map indicates the presence or absence of gerrymandering.

10/23/24 **Transitions in a Mathematical Career** **Rosemarie Bongers, UC Merced**

As an early graduate student, I was a man who was only interested in harmonic analysis and the idealism of pure mathematics; now I am a transgender woman who does a mix of pure math and educational research while working as a teaching professor. In this talk, I will tell a story about these transitions along multiple axes within mathematics. I'll also discuss how my research and teaching have played a role in developing a completely different practice as a mathematician, and how this fits into the broader mathematical community.

10/30/24 **Modeling the Enterprise: My Career at a National Laboratory** **Carol Meyers, Lawrence Livermore National Laboratory**

In this talk, we delve into new theoretical findings as to the way that the Mean-Median Difference and Partisan Bias can act on district maps. These results reveal unexpected and less-than-ideal properties of each of these metrics. Given that the space of potential maps in real US states (with real partisan data) is far more restricted than the space of all theoretical maps, one might wonder whether these metrics actually exhibit problematic behavior on maps using real US data. We answer that in the affirmative by using a recently designed method to create ``extreme maps" using US states and partisan data.. Our main results are that the Mean-Median Difference and Partisan Bias cannot distinguish more extreme maps from less extreme maps. The other metrics are more nuanced, but when assessed on an ensemble, none perform substantially differently from simply measuring the number of districts won by a fixed party.

11/6/24 **Why Twelve Tones? The Mathematics of Musical Tuning** **Emily Clader, San Francisco State University**

If you've played a musical instrument, you may remember that Western music is based on a scale with twelve notes: C, C#, D, D#, and so on. But why divide the scale into twelve steps, rather than some other number? We'll answer this question purely mathematically by encoding a "scale" as a set of numbers of a particular form and using the mathematics of continued fractions to see that certain scale sizes---including size twelve---are as close as possible to evenly-distributed. Along the way, we'll see how math research can turn up in unexpected places. No prior knowledge of music, and no special math background, will be assumed.

11/13/24 **Fast Simulation of the Rule 30 Cellular Automaton & Other Unsolved Problems** **Oleksiy Al-saadi, Sonoma State University**

The analysis of run-time complexities is a major component of algorithm design. One interesting combinatorial object that has gained popularity for its visual flair is the cellular automaton (CA for short), a structure that is essentially composed of a row of colors that change according to some given rule icons. One particular CA, known as Rule 30, is infamous for its notoriously chaotic nature and perceived lack of structure. Nevertheless, there are unclaimed cash prizes associated with Rule 30. In a search for linear-time computation of Rule 30, we discover a faster (but not linear) method for calculating the colors of distant rows for any given elementary CA.

11/20/24 **Controllability of Shapes through Landmark Manifolds** **Sylvie Vega-Molino, University of Bergen** *****via Zoom**

In this talk we will discuss a recent project wherein landmark manifolds are used to study diffeomorphisms of shapes. This is of interest both independently and in applications for other works, and will serve as an introduction to a number of ideas in differential geometry accessible to a general mathematical audience. Landmark manifolds are an abstraction that allow us to use discrete points to approximate shapes. We show that in the Euclidean space, we can preselect two vector fields such that their flows will be able to take any n-landmark to any other, regardless of the number of points n used. This project is a joint work with Erlend Grong.

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