An Invitation to Enumerative Geometric Combinatorics
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 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 1

Measuring to the Stars: The Apotheosis of Trig
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 earth's size, 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 8

The Statistical Selection of Stocks and Opportunities to Get Involved in Statistics
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 some results I do on the ranking and selection of comparable units, useful for choosing stocks based on historical performance or picking restaurants based on reviews.

Feb 22

Sudoku and Set Theory
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.

Mar 15

Electric Power and Complex Numbers: Imaginary Axis to the Rescue!
Talks may change: Please confirm with the Department of Mathematics and Statistics

The Joy of Statistical Consulting, Mathematical Research, Programming, and Modeling!
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 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 story.

Mar 1

Human Depend on Natural Ecosystems on a Global Scale, So It Is Important to Establish Robust Methods for Management in Ecology
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 the transmission of infectious diseases, and damaging forests and other ecosystems. Despite decades of research, effective management of these pests remains a challenge. We will discuss the complete 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 15

No Talk — Spring Break

Book Embeddings of Graphs
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 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!

Mar 29

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 5

Linear Algebra and Color Vision
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 Keith Devlin, Stanford University Emeritus; Mathematician in Residence, Sonoma State University” and “what does a television set look like to a 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 12

Using Mathematics to Try to Understand Information—a Story From the Early Days of the World Wide Web
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 things they cared 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 19

Modeling the Evolution of Coronaviruses Using Mathematics and Machine Learning
The COVID-19 pandemic has shown the importance of developing models that can predict what wild animal viruses 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.

Apr 26

An Analog of Traditional Calculus As We Know It
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 3th derivative? These questions are 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.