M*A*T*H COLLOQUIUM

Wednesdays 4 p.m. • Darwin 103 • Coffee, Tea & Cookies @ 3:45

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

Aug 31 **A Mathematical Model for the Aurora** — **Mark Woods, Rensselaer Polytechnic Institute**

This talk will focus on the physics of the aurora (for example, the Northern Lights) and a mathematical model for simulating auroral emissions. Specifically, the interplay between the solar wind, the geomagnetic field, and the upper atmosphere is shown. A mathematical model is given and the difficulties in solving it are discussed. It is then shown how the output of this model can be used to compute auroral light emissions.

Sep 7 **Sometimes $\pi = 4$** — **Cornelia Van Cott, University of San Francisco**

We will discuss different metrics on the plane and observe how they determine the geometry of the plane, including the shape of circles and the associated value of π. From this new vantage point, π can be any of an *infinite number* of different values. But there are several constraints for these values of π—not every number is possible. Come and find out more!

Sep 14 **Computing with Harmonic Functions** — **Sheldon Axler, San Francisco State University**

If you wrap a basketball with an electric blanket and you know the temperature distribution on the electric blanket, how can you find the temperature distribution inside the basketball? What if the basketball is replaced by a football (an ellipsoid instead of a sphere)? These questions lead to harmonic functions. Interesting theoretical and computational issues connected to these questions lead to exciting mathematics and surprisingly beautiful examples. No prior knowledge of harmonic functions will be needed to enjoy this talk.

Sep 21 **Coloring Geometrically Defined Graphs** — **Ellen Veomett, St. Mary's College of California**

This talk will take us through a journey of graph coloring. We'll start with some basic definitions and the well-known four and five color theorems. We'll also discuss the fascinating question of the chromatic number of the plane. Finally, we'll talk about new results on box graphs, which are graphs defined using blocks and their intersections. This talk will be extremely accessible, while at the same time including some modern research topics.

Sep 28 **From the Abacus to the iPhone** — **John Martin, Santa Rosa Junior College**

During the seventeenth century several individuals began working on ways to coax answers to arithmetic problems from metal. This activity led to the invention of the first mechanical calculators, the precursors to our modern computers. In this presentation, we will explore the history of these machines and the lives of the mathematicians who invented them.

Oct 5 **Where Do Kepler's Laws Hold?** — **Corey Shanbrom, CSU Sacramento**

The Kepler Problem is among the oldest and most fundamental problems in mechanics. Its solution describes the motion of a planet around a sun, and famously yields Kepler's Three Laws of Planetary Motion. The problem makes sense in curved geometries like spheres and hyperbolic spaces. Do the laws still hold? We answer this question and investigate the Kepler problem in a new and strange geometry: the Heisenberg group, where a straight line is a helix.

Oct 12 **Revisiting the Unit Circle: Introducing students to trig functions through the unit circle** — **Jon Southam, Sonoma Valley High School**

Students are traditionally introduced to trigonometry through ratios of similar right triangles. But when they calculate missing sides or angles of triangles, their calculators give them long strings of digits for sine, cosine, and tangent values that can be confusing, and worst of all off-putting. We will explore an alternative introduction to trigonometry for students, and current research on using the unit circle to strengthen students' understanding of trigonometry. And, of course, mathematics history needs to be taken into account so we will also explore origins of trigonometry in terms of its initial use in the cosmos and in the classroom.

Oct 19 **A Selection from Kvant Selecta: On Removing Parentheses with D.B. Fuchs** — **Tyler Evans, Humboldt State University**

Kvant (Quantum) is a Russian mathematics magazine published for high school and university students. The magazine was initiated in 1970 by a group of prominent Soviet physicists and mathematicians, and its editorial board and list of contributing authors has consisted of the very best Russian academics in both fields. In this talk, we will explore a Kvant article by D.B. Fuchs in which a beautiful connection is made between Euler's function, partitions of positive integers, and special numbers that occur in theoretical physics. The talk is accessible to an audience familiar with polynomials and their multiplication.

Oct 26 **My Favorite Automorphisms** — **Emille Lawrence, University of San Francisco**

In this talk, I will convince you that the group of automorphisms of a mathematical object is, indeed, a gateway to understanding the object and is rich with compelling questions. We will survey some of my favorite automorphism groups, which may become some of your favorite automorphism groups.

Nov 2 **Fun with Magic Hexagons and Number Theory** — **Jean Bee Chan, Sonoma State University, Emerita**

First we will construct some magic squares. Next we will venture into magic hexagons. It is known that there are 880 different 4 by 4 magic squares. How many magic hexagons are there? A bit of number theory will give us an answer. Bring pencil and paper to join the fun.

Nov 9 **Evaluating Euler Sums and Some Variants** — **Kenneth Brown, Ciena, Corp.**

In this talk we will discuss harmonic numbers and sums involving them. We will demonstrate a novel way to represent these sums as definite integrals, allowing us to find exact values for a family of sums that were previously only known numerically. Along the way, we will see the basics of generating functions, the Riemann zeta function, and some interesting connections to other areas of mathematics.

Nov 16 **Riemann, Siegel, and the Zeros of Zeta** — **David Sklar (San Francisco State) and Eric Barkan (Consultant)**

Bernhard Riemann (1826-1866) was one of the greatest mathematicians of the 19th century. His published work in number theory consisted of just one eight page paper. In this 1859 paper he obtained a formula for the number of primes less than or equal to a given number x, and revealed the deep connection between the distribution of primes and the zeros of an analytic function now called the Riemann zeta function. In 1932 an important new representation of the zeta function, not contained in the 1859 paper, was recovered from Riemann's very rough notes by the great twentieth century mathematician and scholar, Carl Ludwig Siegel. In this talk we look at some of the history and mathematics that came out of Riemann and Siegel's unusual collaboration.

Nov 23 **No Talk—Thanksgiving**

Nov 30 **The Distinguishing Number and the Distinguishing Chromatic Number of Graphs** — **Izabela Kanaana, Sonoma State University**

The distinguishing number of a graph G is the minimum number of colors needed to color the vertices of G so that the only automorphism of G that preserves colors is the identity. Similarly, the distinguishing chromatic number of a graph G is the minimum number of colors needed to properly color the vertices of G so that the only automorphism of G that preserves colors is the identity. In this talk we study the distinguishing number and the distinguishing chromatic number for various families of graphs.

Dec 7 **No Talk—Last week of instruction**

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