Spring 2015 82nd Series

M*A*T*H COLLOQUIUM

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

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

"Mathematics is the process of turning coffee into theorems" Paul Erdös

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Jan 28 — **Partitions are Everywhere!** — **Ben Ford, Sonoma State University**

How many ways are there to arrange 11 dots in rows of distinct length, such that each row contains no more dots than the row above it? How about in rows of odd length (but not necessarily all distinct length)? For someone whose field is abstract algebra, I spend a lot of my time trying to find clever ways to count arrangements of dots, called partitions. We'll explore the remarkable ubiquity of partitions, and look at some recent work by Ken Ono and others about patterns in partition numbers, generalizing patterns first noticed by Ramanujan in 1919.

Feb 4 — **The Limit of Humanly Knowable Mathematical Truth, Gödel's Incompleteness Theorems, and Artificial Intelligence** — **Tim Melvin, Santa Rosa Junior College**

In 1931, Kurt Gödel published one of the most infamously not-famous (enough) works in mathematics: his incompleteness theorems. During this talk we will explore the history behind his incompleteness theorems, the ideas behind them, and how they relate to artificial intelligence and the limits of humanly knowable mathematics.

Feb 11 — **Machine Learning and Games** — **Kristin Lui, UC Davis and KDD Lab**

From the Three Laws of Robotics to Skynet, the human imagination has explored many facets of artificial intelligence. Intelligent robots are becoming a reality thanks to advances in machine learning. In this talk, I will introduce machine learning algorithms that have made it possible for computers to "solve"—beat or draw with humans—games from tic-tac-toe to chess. Furthermore, I will explain why machines still cannot match humans in Go.

Feb 18 — **The Joy of Mathematica** — **Math 180 Students, Sonoma State University**

You thought Mathematica could only take derivatives and integrate? Come see the amazing student projects from Nick Dowdall's Fall 2014 Mathematica class.

Feb 25 — **Arithmetic Progressions in the Polygonal Numbers** — **Kenneth Brown, Cyan, Inc.**

In this talk we will investigate arithmetic progressions in the polygonal numbers with a fixed number of sides, paying special attention to the case of square and triangular numbers. We first show that four-term arithmetic progressions cannot exist. We then describe explicitly how to find all three-term arithmetic progressions. Finally, we show that not only are there infinitely many three-term arithmetic progressions, but that there are infinitely many three-term arithmetic progressions starting with an arbitrary polygonal number.

Mar 4 — **Computational Neural Algebra** — **Elizabeth Gross, San Jose State University**

In 2014, two teams of researchers won the Nobel Prize in Medicine for discovering place cells, neurons that fire when an animal enters a particular region in their environment. These regions are called place fields and are experimentally known to be convex, which raises interesting mathematical questions. For example, we can ask whether a set of neuron firing patterns could have resulted from a collection of convex place fields. In this talk, we introduce place fields and give a partial answer to this question using computational algebra.

Mar 11 — **Introduction to Ehrhart Polynomials** — **Fu Liu, University of California, Davis**

The A polytope is a higher-dimensional generalization of polygons. We say a polytope is integral if all of its vertices have integer coordinates. Given an integral polytope P, for any positive integer m, we denote by $i(P,m)$ the number of lattice points inside the *mth* dilation mP of P. Eugene Ehrhart discovered in 1960s that $i(P,m)$ is a polynomial in m of degree $\dim(P)$. So we often call $i(P, m)$ the Ehrhart polynomial of P. In this talk, I will first survey some well-known results related to Ehrhart polynomials, and then discuss some of my own results on this subject. No previous knowledge on this topic is required.

Mar 18 — **Spring Break — No Talk**

Mar 25 — **Predicting Rainfall at Fairfield Osborn Preserve from Measurements at Bodega Marine Lab** — **Math 470 Students, Sonoma State University**

The current drought—and historical local flooding—mean that officials, farmers, and researchers are interested in better methods for predicting precipitation. The Fall 2014 Mathematical and Statistical Modeling class partnered with Dr. Christopher Halle, collaborator on a new weather station at SSU's Fairfield Osborn Preserve (FOP). They used historical precipitation data to determine whether measurements at Bodega Marine Lab could reliably predict rainfall in the Rohnert Park area (specifically, at FOP)—and thus hopefully increase the lead time for flood preparation. Student groups will present their models, which draw on topics from calculus and statistics.

Apr 1 — **Infinitesimal** — **Bill Barnier, Professor Emeritus, Sonoma State University**

The concept of the real line as composed of distinct and infinitesimal (infinitely small) parts was key to the development of calculus. We will show how mathematicians made important discoveries by reasoning with infinitesimals. However, the concept of infinitesimals ("ghosts of departed quantities") was not given a rigorous foundation until the development of the hyperreal numbers in the mid twentieth century.

Apr 8 Math Festival (Tickets Required 4:15pm) — **Harmonious Equations: A Mathematical Exploration of Music** — **Dave Kung, St. Mary's College of Maryland**

with Elizabeth Roe (piano) and Saeunn Thorsteinsdottir (cello) of Trio Ariadne, Weill Hall Artists-in-Residence at SSU

Special Location: Schroeder Hall, Green Music Center **Special Time:** 4:15-5:30 (tea and cookies at 3:45)

Mathematics and music seem to come from different spheres (arts and sciences), yet they share amazing commonalities—which we will explore. The mathematical study of a single vibrating string unlocks a world of musical overtones and harmonics—and even explains why a clarinet plays so much lower than its similar-sized cousin, the flute. Calculus and its extensions show us how our ears hear differences between two instruments even when they play the same note at the same loudness. Finally, abstract algebra describes the structures beneath the surface of Bach's magnificent canons and fugues. Throughout the talk, mathematical concepts will come to life with musical examples played by the speaker and SSU's musicians in residence.

Supported by a Green Music Center Academic Integration Grant, Co-Sponsored with the Department of Music

Tickets required (free): email math@sonoma.edu

Apr 15 — **Crowding Out in Charitable Giving: Attitudes** — **Mike Visser, Department of Economics, Sonoma State University**

It has been demonstrated that private charitable giving is crowded out (reduced) by government financing. Is the degree of crowding out affected by the degree to which an individual associates with a particular cause? We use instruments from social psychology to measure individuals' attitudes toward a particular cause; our hypothesis is that more passionate donors will persist in giving at higher rates. That is, attitudes may be an indicator of one's motives for charitable giving, and thus suggest an underlying model of social preferences.

Apr 22 — **The Origins of Fractals: From Pathological Monsters to Fractals Everywhere** — **Wyndham Galbraith, Sonoma State University**

In the 1872, Weierstrass introduced one of the first continuous but nowhere differentiable functions. Such functions were deemed "monsters" and contributed to the period of great philosophical crisis in mathematics at the turn of the 20th century. Along with this function, many sets and geometrical objects were imagined that defied classical description. We see the study of fractal theory can provide us a useful lens for seeing that, rather than being the monstrous exceptions, these objects are the rule in our physical surroundings.

Apr 29 — **The Pythagorean Proposition and the Enduring Beauty of Mathematics** — **John Martin, Santa Rosa Junior College**

In the 1800's Charles Dodgson observed, "The Pythagorean theorem is as dazzlingly beautiful now as it was the day when Pythagoras first discovered it." In this talk, we will explore the history of the theorem and the beauty that it still reveals today.

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