Archived GAUSS
2014/15

September 5, 2014, 4:00pm: David Heywood (Fresno State Student)

Title: *Multiplier Sequences*

Abstract: Suppose we have a polynomial with all real roots. If we take that polynomial and multiply it term-by-term by the terms of a sequence, does the resulting polynomial still have all real roots? Of course, the answer depends on the sequence and the polynomial. Surprisingly, though, there are some sequences that preserve real roots regardless of the polynomials that we start with. These are called multiplier sequences.

In this talk, we will discuss some known facts about multiplier sequences. Along the way, we will look at examples and extend our discussion to other types of sequences that have interesting properties. This informal presentation should be very accessible to students of all levels.

September 19, 2014, 4:00pm: Tamás Forgács (Fresno State)

Title: *Apolar derivatives and a generalization of the Gauss-Lucas theorem*

Abstract: This talk will investigate a generalization of the real derivative, and its connection to the location of the zeros of a polynomial.

September 26, 2014, 4:00pm: Aramayis Orkusyan (Fresno State Student)

Title: *Optimizing Medical Image Reconstruction*

Abstract: The medical field relies heavily on CT imaging to create visual representations of a patients internal anatomy through noninvasive means. These images are produced from X-ray data collected by the CT scanner; however, the observed data is not an exact representation of the patient's anatomy and requires computational methods to reconstruct the original image. In this talk, we will discuss the traditional method for image reconstruction and their disadvantages, and investigate more novel approaches for image reconstruction.

October 10, 2014, 4:00pm: Thoa Tran (Fresno State Student)

Title: *Ramsey Numbers*

Abstract: The Ramsey number $R(k,l)$ gives the solution to the party problem which asks which is the minimum number of guests, $R(k,l)$, to be invited to a party so that at least k will know each other or at least l will not know each other. Ramsey's theorem states that such a number exists for any positive integers k and l.

In the language of graph theory, Ramsey's theorem states that given any two positive integers, k and l, there is always a smallest integer $R(k,l)$ such that any coloring, using red and

blue, of the edges of a complete graph in $R(k, l)$ vertices will contain a complete subgraph of size k that is all red, or a complete subgraph of size l that is all blue.

In this talk, we will discuss Ramsey numbers, and show an upper bound and a lower bound for them.

October 17, 2014, 4:30pm: Elaina Aceves, Jamie Dewey, and Jennifer Elder (Fresno State Students)

Title: *Public-key Cryptography*

Abstract: Encryption is everywhere. It's what prevents people from looking at your email, bank account, text messages, or anything else you would like to electronically secure. And most of this encryption deals with products of large prime numbers. Most people cannot simply factor $53, 791, 321$ at the drop of a hat, which makes it very useful for encryption.

In this workshop, we present a method for encoding words using prime numbers and long division that is accessible in a high school classroom (and in a college Math Club too).

October 24, 2014, 4:00pm: Samuel Macneil (Fresno State Student)

Title: *How to Guard a Museum*

Abstract: Suppose the manager of a museum wants to make sure that at all times every point of the museum is watched by a guard. The guards are stationed at fixed posts, but they are able to turn around. How many guards are needed? The art gallery theorem gives us a maximum number of guards required for an n-walled convex polygon.

In this talk, we will go over the proof of this theorem as detailed in Proofs from The Book, by Aigner and Ziegler, as well as some variants of the art gallery problem.

October 24, 2014, 4:30pm: Kelsey Friesen, Simerjit Kaur, and Thoa Tran (Fresno State Students)

Title: *Exploring the Fibonacci Numbers*

Abstract: The Fibonacci numbers can be used to model or describe a variety of phenomena in mathematics, art, and nature, even the human body!

In this talk, we will go over some history of the Fibonacci numbers and where in the real world they pop up. As funny as it sounds, we'll start off by discussing how Leonardo of Pisa (who nicknamed himself Fibonacci) related these numbers to the reproduction of rabbits. Another application of the numbers is to use them to create beautiful equiangular spirals.

We will wrap up exploring the Fibonacci numbers by investigating how they are related to the "golden ratio", the ratio deemed most aesthetically pleasing to the human eye when used in architecture and art.

October 31, 2014, 4:00pm: Marat Markin (Fresno State)

Title: *Free AC check ☺: The Axiom of Choice, its equivalents, and applications*

Abstract: The Axiom of Choice (AC), formulated by Ernst Zermelo in 1904 and considered controversial for a few decades after that, is now a basic assumption used in many parts of mathematics. A vast number of important mathematical results require AC for their proofs.

In this talk we are going to formulate AC and its equivalents, and see how it can be applied to proving the existence of a basis in any vector space, and a set of real numbers that is not Lebesgue measurable.

Consider our discussion a "free AC check" making no pretense to be an in-depth treatment of such a fundamental principle of mathematics.

November 14, 2014, 4:00pm: Tamás Forgács and Aramayis Orkusyan (Fresno State Faculty/Student)

Title: *You mean math isn't all solved...?*

Abstract: This talk will introduce you to the general idea of undergraduate research. We'll discuss reasons for doing it, it's role in your education, and various opportunities to engage in such both here at Fresno State, as well as at many other universities in the country through programs called REUs (Research Experiences for Undergraduates). You will hear from a student who has recently participated in an REU, and from professors who have recently mentored students in REUs. This will sure to be a life changing event, don't miss it.

December 5, 2014, 4:00pm: Samuel Macneil (Fresno State Student)

Title: *Recounting the rationals*

Abstract: A new way of counting the rationals has been recently discovered by Calkin and Wilf. It relies on very simple arithmetic and on a really clever recursive function.
The work discussed in this talk appears in Proofs from The Book and the American Mathematical Monthly 107 (2000).

December 5, 2014, 4:00pm: Tamás Forgács (Fresno State)

Title: *A module for a Complex Analysis class*

Abstract: Professor Forgács will give a presentation on the Fourier transform. The goal of the presentation is to test out an idea recently proposed at a conference for revitalizing complex analysis.

January 30, 2015, 4:00pm: Rozy Vig

Title: *Math Teaching & Learning: Representations Conceptualized*

Abstract: Representational practices are fundamental to the discipline of mathematics.

In an era of online learning and technology rich classrooms, the role of representations becomes increasingly important. However, we lack an adequate understanding of how teachers and students use representations to make sense of mathematics. In this talk, I set forth a framework for conceptualizing representations as they relate to math teaching and learning. I situate the framework in my personal research trajectory, starting with my dissertation work which consists of student focused clinical interviews centered on the use of a technology tool designed to support their understanding of rational numbers and moving towards large-scale randomized control studies investigating the efficacy and effectiveness of classroom interventions which include various forms of representations with varying functions. The framework is further expanded as I consider secondary data analysis on an international study of teacher knowledge as well as my own teaching experiences. I end with an ever increasing list of open questions I hope to explore in future collaborations with colleagues and students and welcome all questions and comments related to this work.

February 6, 2015, 4:00pm: Emily Cilli-Turner (Salve Regina University)

Title: *Measuring Learning Outcomes and Attitudes in a Flipped Introductory Statistics Course*

Abstract: Recent studies have highlighted the positive effects on learning and retention rates that active learning can have on the classroom. One method of active learning is the flipped classroom, where content transmission occurs outside of the classroom environment and problem solving and learning activities become the focus of classroom time. This talk will report on the results of two studies conducted in flipped and traditional introductory statistics classroom environments. The first study compared these two types of pedagogy and measured student achievement on traditional assessments as well as student attitudes toward the flipped classroom environment. The second study used a statistics concept inventory to identify course material where learning is enhanced by the flipped pedagogy. Results from each of these studies will be discussed as well as implications for the teaching of introductory statistics.

February 27, 2015, 4:00pm: Kelsey Friesen and Sarah McGahan (Fresno State)

Title: *Writing Numbers as the Sum of Two Squares*

Abstract: In this talk, we discuss a solution to a classical question in number theory - when can a number be written as the sum of two squares? In particular, we will answer the question when can a prime number be written as the sum of two squares? Our solution to this problem comes from "Proofs from the Book," by Aigner and Ziegler. We will begin by classifying the prime numbers, and then discuss solutions to our problem for each type of prime.

March 06, 2015; 4:30PM in S2 307: Brennen Fagan and Aramayis Orkusyan (Fresno State)

Title: *On the Inoculation of Networks, Big and Small*

Abstract: As complex computer networks become more integral to our life, it is becoming more important to create effective and efficient defenses against cybercrime. An introductory foundation on the nature of computer networks and their representation as graphs will be outlined, and two methods will be presented for immunizing these computer networks. The first method will focus on small networks and use centrality measures to form an inoculation scheme. The second method will then transition to large-scale complex networks, and discuss inoculation schemes based on random processes that rely on the scale-free nature of large networks.

March 06, 2015; 4:00PM in S2 307: Majerle Reeves and Manuel Lopez (Fresno State)

Title: *Modeling an Influenza Virus*

Abstract: Every year before the influenza season begins, the United States focuses its efforts on vaccinating both the young and the elderly. This study uses data from the CDC, WHO, and CDPH and an SEIR model with a travel component to track the spread of the seasonal flu virus in California. The purpose of this study is to prove or disprove that the current immunization scheme is the most effective. The model will be used to find an effective vaccination scheme. The knowledge obtained will allow for earlier production of flu vaccines, a reduction of waste by preventing the over-vaccination of particular age groups, and help prevent spread of the influenza virus.

March 06, 2015; 1:00PM in PB 428: Monica Cuevas (Fresno State)

Title: *Conic Sections*

Abstract: After an overview of Apollonius' life and his work on conic sections, this talk will demonstrate and prove a few of Apollonius? theorems, using GeoGebra. Finally we will discuss Kepler?s work related to conic sections.

March 27, 2015; 4:00PM in S2 307: Cynthia Cervantes and Simerjit Kaur (Fresno State)

Title: *Two times* $\pi^2/6$

Abstract: There is a classical, famous and important result by Leonhard Euler from 1734, stating that the infinite sum of the reciprocals of the squares of natural numbers is equal to $\pi^2/6$. In this talk we will present two elementary but elegant and clever proofs of Euler's result. These proofs involve double integrals and were taken from ?Proofs from THE BOOK? by M. Aigner and G. Ziegler.

April 10, 2015; 4:30PM in S2 307: Thoa Tran (Fresno State)

Title: *Hilbert?s third problem: decomposing polyhedra*

Abstract: The great mathematician David Hilbert proposed 23 problems in 1900, and the third on Hilbert?s list of mathematical problems is related to the question: Given any two polyhedra of equal volume, is it always possible to cut the first into finitely many polyhedral pieces which can be reassembled to yield the second? The problem was solved by Hilbert?s student, Max Dehn, who proved that the answer in general is ?no? by producing a counterexample.
In this talk, we will go over an elementary reworked proof of Dehn?s original proof, as given in ?Proofs from THE BOOK? by M. Aigner and G. Ziegler.

April 10, 2015; 4:00PM in S2 307: Jennifer Elder (Fresno State)

Title: *Cayley?s formula for the number of labeled trees*

Abstract: Cayley?s formula for the number of labeled trees is a famous result in Combinatorics and Graph Theory. In this talk, we will present two of the more interesting and elegant proofs for this result: one using a recursive formula, and one using double counting. These proofs were taken from "Proofs from THE BOOK" by M. Aigner and G. Ziegler.

April 24, 2015; 4:30PM in S2 307:Jamie Dewey and Hillary Bese (Fresno State students)

Title: *Plane and the Slope Problem*

Abstract: In this talk, we will be discussing problems from "Proofs from THE BOOK" by M. Aigner and G. Ziegler. First, we will look at a problem proposed by Professor Sylvester in 1893: ?Prove that it is not possible to arrange any finite number of real points so that a right line through every two of them shall pass through a third, unless they all lie in the same right line.? We will then look at some theorems resulting from this question before moving on to the slope problem. In this last part, we will look at configurations of points in the plane that determine ?relatively few? slopes.

April 24, 2015; 4:00PM in S2 307: Elaina Aceves (Fresno State student)

Title: Five-coloring Planar Graphs Lines in the plane

Abstract: The four-color problem in graph theory is a famous result that states that four colors are sufficient to color the regions of any plane map such that regions which share a common boundary do not have the same color. It turns out that coloring the regions of a map is the same task as coloring the vertices of a plane graph. Unfortunately, at this point, no "beautiful" proof of the four-color problem has been given such that it can be placed in "Proofs from THE BOOK" by M. Aigner and G. Ziegler. Thus, this talk will present how to prove that any planar graph can be five-colored. This proof is taken from "Proofs from THE BOOK".