M*A*T*H COLLOQUIUM

Fall 2021 95th Series

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

"The book of nature is written in the language of mathematics" - Galileo

Wednesdays at 4:00pm on Zoom
https://bit.ly/SSU-Math-Colloq-F21

Phone: (707) 664-2368 www.sonoma.edu/math

Series supported by Instructionally-Related Activities Funds

Sept 1

Flipped Again by Covid — **Rhonda Fitzgerald, Norfolk State University**

Successful mastery of concepts taught in mathematics courses proves essential to the pursuit of any STEM degree. The flipped classroom approach was implemented in a pre-calculus course with the use of supplemental instructors to build math confidence, bolster student success and enhance students' meta-cognitive skill. During the Spring 2020 Semester, COVID flipped the flipped classroom and additional strategies needed to be implemented. Overall, students' who completed the Pre-Calculus course with the Flipped Classroom model had a higher GPA each semester in which the grades were collected for the evaluation. In this talk, I will discuss the flipped classroom approach, the effect of COVID on these methods, and the student outcomes.

Sept 8

Symmetries of Surfaces — **Marisa Loving, Georgia Institute of Technology**

In this talk, we will touch on some of the motivation for studying surfaces and their associated mapping class groups, which is the collection of symmetries of a surface. We will also explore some of the areas of mathematics that interact with the study of surfaces—from topology and geometry to algebra and combinatorics, just to name a few. The examples we explore will be guided by my own research (along with various collections of my coauthors).

Sept 15

Let the best one stay: Optimal Conditions for the Assembly of Host-Beneficial Microbiomes — **Oyita Udiani , Virginia Commonwealth University**

Many animals and plants recruit beneficial microbes from the environment to defend against pathogens. Ecological partnerships of this kind are called 'defensive mutualisms' and provoke many fascinating research questions. For instance, is it possible for a host to select the "best" partners from the environment without ever knowing their qualities (i.e., beneficial vs. harmful)? I will present a mathematical model of a mechanism for partner choice which conceptualizes interactions between two groups of bacteria (A and B) that battle for space/food within the host's habitat. The model predicts a variety of outcomes for the game, including competitive exclusion, coexistence and bistability.

Sept 22

Cultivating a Mathematical Toolbox — **Katy Martinez, Los Alamos National Labs**

At times, the tools needed to address various obstacles may need to be assembled from various corners of the field of mathematics and statistics. In this talk I will share methods and results from my various projects by looking back at the key skills, either concrete mathematical techniques, or more subjective research competencies, I needed to tackle several projects I have completed. In one project, I investigated methods from both computational differential equations and fundamentals of Bayesian statistics to design and quantify my models for spatio-temporal spread of Ebola in West Africa. In another project, I melded optimization theory, clustering algorithms, and dimension reduction methods to arrive at workable data for a Dengue risk factor analysis. Conversely, while a problem can be complex a solution can be simple. I have explored risk factors for Dengue using obscenely simple linear models, and can generate meaningful assessments of the demographic and environmental factors impacting the spread of mosquito-bourne viruses in Brazil using this basic approach.

Sept 29

A Geometric Diophantine Equation — **Kristin DeVleming, University of Massachusetts at Amherst**

Algebraic geometry is the art of applying algebraic techniques to solve geometric problems while also applying geometric ideas to solve algebraic problems. In this talk, we will explore both perspectives. A standard geometric problem asks, given a family of objects, what can they degenerate to? When the object is the (projective) plane, it turns out that the possible deformations are governed by a simple Diophantine equation, and we will algebraically determine all solutions and thus completely solve the geometric problem. If time allows, we will go one dimension higher, to an equation that we cannot algebraically solve, and use geometry to guide us to infinitely many solutions.

Oct 6

Math and Codes: Yesterday, Today, and Tomorrow — **Alexander Diaz-Lopez, Villanova University**

For more than 2,500 years, humans have been "hiding" text in order to communicate without intermediaries understanding the messages. We will discuss techniques and methods developed through history, including monoalphabetic ciphers, polyalphabetic ciphers, mechanical ciphers, and more recently, public-key cryptography. We will end the talk discussing what the future might hold in this area. No background is needed to understand 50% of the talk and for the other 50%, you might need to know how to multiply and divide.

Oct 13

Rainbow Numbers for $x + ky = z$ — **Anisah Nu'man, Spelman College**

An exact r-coloring of a set S is a surjective function $c:S \rightarrow \{1, 2,\ldots,r\}$. The rainbow number of a set S (for example, $\{10, 20, 30, 40\}$) for an equation (such as $x_1 + x_2 = x_3$) is the smallest integer r such that every exact r-coloring of the set S contains a "rainbow solution:" a solution to the equation in which all values are assigned different colors (so in our example, either $\{10, 20, 30\}$ or $\{10, 30, 40\}$ would have to be mapped to three different colors). We will explore upper and lower bounds for the rainbow number of the set $\{1, 2,\ldots,n\}$ for the equation $x + ky = z$, where k is a positive integer.

Oct 20

Mathematical Models in the Sociological Imagination — **Nathan Alexander, Morehouse College**

This talk presents an abstract study of mathematical modeling using methods from philosophy and sociology. We will consider a model of neighborhood composition to discuss land ownership, gentrification and their relations to broader social and legal systems. Participants will explore the value of mathematics for critical democracy, mutual aid, and social action. This talk is math friendly and intended for all regardless of their mathematical background - so bring a friend!

Oct 27

Harnessing the Power of Artificial Intelligence and STEAM — **Loretta Cheeks, Chief Executive Officer at DS INNOVATION - AI**

Harnessing the power of AI and STEAM is resulting in the emergence of innovative technologies, transforming the different ways that humans experience space in our world and creating novel approaches to solve problems across the spheres of learning environments, business and society. Drawing on many years of practices, programming, and research, this presentation contextualizes learning and innovative expressions that take place at effective interconnections of AI and STEAM that is promising to assist learners and educators of all levels. This talk will discuss compelling AI and STEAM use cases and design approaches to engaging in community through formal and informal learning environments.

Nov 3

A Mathematical Path to the Academy Awards — **David Haumann, Pixar (Retired)**

Parental influences and the race to the moon fostered my early interests in physics, filmmaking, and computers, which led to a career in computer graphics and animation. This talk will provide a sampling of how vectors and linear algebra are used to represent and transform virtual geometry. Adding physical properties allows this to be realistically animated using computer simulations; a common practice in today's Hollywood productions, but an early example was the Pixar short "Geri's Game".

Nov 10

Using Statistics to Improve Social & Educational Programs: An Introduction to the Field of Program Evaluation
Silvana McCormick, Redwood Consulting Collective

Do you like statistics and are you also passionate about making the world a better place for all people? I'd like to introduce you to program evaluation, an exciting and fulfilling field that relies heavily on the use of statistics and applied research skills. I will describe my journey starting as an SRJC and SSU student, through graduate school, and into my current role as an independent consultant. I'll talk about the different sectors in which evaluators work, how we use statistics to evaluate and help improve different types of social and educational programs, and share some of the statistical techniques we've used in our recent evaluation projects.

Nov 17

My Journey to Finite Group Theory — **Dandrielle Lewis, High Point University**

I am a mathematician, and if I can become one so can you. In my research, I study classifications of subgroups of a direct product of two groups. My studies led to some exciting undergraduate research projects involving subgroup classifications in products of groups. In this presentation, I will share with you my journey to finite group theory, and I will introduce groups and share with you a few projects that I have worked on with undergraduates.

Nov 24 — **NO TALK—Thanksgiving Break**

Dec 1

Social Organization and its Effects on Disease Spread — **Shelby Wilson, Johns Hopkins University Applied Physics Laboratory**

Individuals living in social groups are susceptible to disease spread through their social networks. The network's structure, including group stability, clustering, and an individual's behavior and affiliation choice all have some impact on the effect of disease spread. Moreover, under certain scenarios, a social group may change its own structure to suppress the transmission of infectious disease. Evidence that social organization may protect populations from pathogens in certain circumstances prompts the question as to how social organization affects pathogenic spread on dynamic networks. We will introduce discrete-time dynamic social network models and discuss the effects of both pathogenic and parasitic epidemics. In each case, we highlight the bi-directional effects of social structure and infection dynamics.

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

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