Speaker Information and Abstracts

Speaker: **Maria Allayioti**
Institution: University of Southern California
Title: ***M-estimation in a diffusion model with application to biosensor transdermal blood alcohol monitoring***
Abstract: With the goal of well-founded statistical inference on an individual's blood alcohol level based on noisy measurements of their skin alcohol content, we develop M-estimation methodology in a general setting. We then apply it to a diffusion equation-based model for the blood/skin alcohol relationship thereby establishing existence, consistency, and asymptotic normality of the nonlinear least squares estimator of the diffusion model's parameter. Simulation studies show agreement between the estimator's performance and its asymptotic distribution, and it is applied to a real skin alcohol data set collected via biosensor.

Speaker: **Lernik Asserian**
Institution: University of Southern California
Title: ***Nonparametric Probability Distribution Estimation in the Prohorov Metric Framework and its Application to the Alcohol Problem***
Abstract: We are motivated by a problem in which the Transdermal Alcohol Concentration (TAC) is measured by an alcohol biosensor, and the goal is to estimate the Blood Alcohol Concentration (BAC) from the observed TAC. We developed a physics-based model as a random parabolic PDE, and the goal is to estimate the probability distribution of the random parameters of this model. We consider nonparametric probability distribution estimation in the Prohorov metric framework to establish the existence and consistency of a least squares estimator. A computational method is applied to develop a finite dimensional approximation. In order to show the convergence of the estimated distribution to the "true" distribution, we simulate data from the "true" distribution, perform the optimization algorithm to obtain the estimated cumulative distribution function, use the Markov Chain Monte Carlo (MCMC) Metropolis Algorithm to generate random samples from the estimated distribution, and perform a generalized (2-dimensional) two-sample Kolmogorov-Smirnov test in order to test the null hypothesis that our generated random samples from the estimated distribution and generated random samples from the "true" distribution are drawn from the same continuous distribution.

Speaker: **Kimberly Ayers**
Institution: Carroll College
Title: ***Stabilization of Quasi-Periodic Orbits of the Random Logistic Map***
Abstract: The logistic map demonstrates a well known example of a period-doubling bifurcation, ultimately exhibiting chaos for parameter values between 3.87 and 4. In the chaotic regime, the map has periodic points of all periods, but these periods are all unstable. In this talk, we examine the stochastic linear map, where the parameter takes values between 3.87 and 4 according to a uniform distribution. The map then exhibits quasi-periodic orbits, but these are still unstable. We will discuss stabilization techniques to find the two distinct period-3 quasi-periodic orbits in the random logistic map.

Speaker: Zhanar Berikkyzy

Institution: University of California, Riverside
Title: *Anti-van der Waerden numbers of graphs*
Abstract: The anti-van der Waerden number of [n], denoted by aw([n], k), is the smallest r such that every exact r-coloring of [n] contains a rainbow k-term arithmetic progression. We will discuss results for 3-term arithmetic progressions on the integers and the integers modulo n. We will then extend the definition to graphs, and improve bounds for trees and Cartesian products. Larger k-term arithmetic progressions will be considered, as well as a connection between the Ramsey number of paths and the anti-van der Waerden number of graphs.

Speaker: **Yesim Demiroglu**
Institution: Harvey Mudd College
Title: ***Applications of Cayley Digraphs to Waring's Problem and Sum-Product Formulas***
Abstract: In this talk, we first present some new proofs (using Cayley digraphs and spectral graph theory) for Waring's problem over finite fields, and explain how in the process of re-proving these results, we obtain an original result that provides an analogue of Sárközy's theorem in the finite field setting (showing that any subset E of a finite field $\mathbb{F}_q$ for which $|E| > \frac{qk}{\sqrt{q-1}}$ must contain at least two distinct elements whose difference is a k^{th} power). Once we have our results for finite fields, we can apply some classical mathematics to extend our Waring's problem results to the context of general (not necessarily commutative) finite rings. If time permits, we will also talk about some sum-product formulas related to matrix rings over finite fields especially about a particular result, which can again be proven using Cayley digraphs and spectral graph theory in an efficient way.

Speaker: **Yujia Ding**
Institution: Claremont Graduate University
Title:***Accelerometer-Based Gait Segmentation: Simultaneously User and Adversary Identification***
Abstract: In this work, we introduce a new gait segmentation method based on accelerometer data and develop a new distance function between two time series, showing novel and effectiveness in simultaneously identifying user and adversary. Our approaches use geometric features to extract walking cycles precisely and employ a new similarity metric to conduct user-adversary identification. This new technology for simultaneously identify user and adversary contributes to cybersecurity beyond user-only identification.

Speaker: **Shanna Dobson**
Institution: California State University, Los Angeles
Title: ***Higher Categorical Traces on Crys(X)***
Abstract: Let X be a DG scheme which is locally almost of finite type. Following a standard construction, to each prestack (locally almost of finite type) Y, we assign a stable infinity-category Y Crys(Y) that has a left realization functor to QCoh(Y) and a right realization functor to IndCoh(Y). Using results that Crys(X) is a Grothendieck abelian category that is locally Noetherian and that Crys(X) has finite cohomological dimension with respect to its t-structure, we investigate higher categorical traces on Crys(X) and survey mixed and noncommutative motives.

Speaker: **Kat Dover**
Institution: University of California, Irvine
Title: ***Deconstructing Clustering Algorithms for High Dimensional Data***
Abstract: Clustering is a large area of data visualization that often involves algorithms generating 2-dimensional representation of data where similar points are visually grouped together. The standard algorithm used for clustering is tSNE, a non-convex method that represents the differences between data points as weighted probabilities in high and low dimensions and then minimizes the 'distance' between these two distributions using the Kullback-Leibler divergence. Despite its wide success, there is still very little mathematical understanding of the algorithm. In this talk, we discuss tSNE and our attempt to better mathematically understand the algorithm by deconstructing it into a simpler algorithm that produces similar results.

Speaker: **Ranthony A.C. Edmonds**
Institution: The Ohio State University
Title: ***Let's Break it Down: Mathematical Atoms in Commutative Rings***
Abstract: Factorization theory is concerned with the decomposition of mathematical objects. One of the earliest and most significant results involving factorization is the Fundamental Theorem of Arithmetic, which states that every integer can be written uniquely as the product of primes. Thus, we can think of prime numbers as the atoms of the integers. We can generalize this idea of unique factorization into atoms to a commutative ring called a unique factorization domain.

In this talk, we will motivate the study of factorization in commutative rings in a variety of algebraic settings. We will also discuss factorization properties in commutative rings weaker than unique factorization, which highlights the different ways in which we can characterize rings based on how their elements break down into atoms.

Speaker: **Hossien Erjaee**
Institution: University of California, Irvine
Title: ***Complexity and its Applications***
Abstract: In recent years, the field of applied nonlinear dynamics has attracted scientists and engineers across many different disciplines to develop innovative ideas and methods to study complex behavior exhibited by relatively simple tools. In this talk, we will discuss some of these tools together with some examples such as heart rate complexity. A common theme among these and many other examples is the underlying universal laws of nonlinear science that govern the behavior in space and time, of a given system. These laws are universal in the sense that they transcend the model-specific features of a system and so they can be readily applied to explain and predict the behavior of a wide-ranging phenomenon, natural and artificial ones. Thus, in this talk, we will try to explain the rich behavior of nonlinear systems by some easy devices that can operate more efficiently comparing with those classical complicated devices or methods.

Speaker: **Nicole Fider**
Institution: University of Arizona
Title: ***A tale of Tic-Tac-Toe: the day my students played***
Abstract: Assigned to a six-student once-weekly workshop (loosely labelled as "supplementary" to the proofs course), I made it my goal to encourage the creative and

social aspects of mathematical problem solving which are often downplayed in computational lower division math classes. I spent several workshops prodding them to work together to reason out the standard beginner-level proofs, but was met with resistance. So, as an icebreaker, I decided to split my students into two teams and I pitted them against each other in a game of Ultimate Tic-Tac-Toe. The students were so intrigued that they asked, "Next week, can we just play this the whole time?" I compromised and during the next meeting, they played variations of Tic-Tac-Toe with each other for over an hour. In this brief talk, I describe how that day unfolded, and why I found their games so heartening.

Speaker: **Erica Graham**
Institution: Bryn Mawr College
Title: ***Uncovering reproductive phenotypes: mechanistic reduction and comprehensive model evaluation***
Abstract: The ovulatory cycle is the result of a tightly regulated system of crosstalk between reproductive hormones generated in the brain and ovary. The complex hormone feedback gives rise to the characteristic oscillatory behavior of the menstrual cycle. Altered hormone regulation may disrupt the cycle, leading to abnormal ovulation and/or fertility. The sheer complexity of this system poses a challenge to identifying precise mechanisms of dysfunction. However, mathematical approaches have been useful in examining pathophysiology, even when precise biological mechanisms are unknown. I will discuss mathematical models of ovulation in the context of general dynamics, the nature of dysfunction, clinical implications, and an algorithmic approach for data- and biology-driven model reduction.

Speaker: **Kelly Isham**
Institution: University of California, Irvine
Title: ***On the number of subrings of prime power index in*** $\mathbb{Z}^n$
Abstract: Liu gave a recurrence relation that allows us to understand the number of subrings of prime power index in $\mathbb{Z}^n$ in terms of the number of $n \times n$ irreducible matrices, $g_n(p^e)$. An $n \times n$ matrix is irreducible if it is in Hermite normal form, the entries in the first $(n-1)$ columns are all divisible by p, and the last column is $(1, 1, ..., 1)^T$. Previous work has shown that $g_n(p^e)$ is polynomial in p when $e \leq 8$ and when $e = n + 1$. In this talk, we describe a new strategy for determining the number of irreducible submatrices using row reduction techniques. We then discuss a new result for $g_n(p^e)$when $e = n + 2$.

Speaker: **Tiffany Jones**
Institution: University of Arizona
Title: ***Analysis of a Novel Helmholtz Approximation Method over Micro and Macro Regions***
Abstract: This presentation will examine a novel approximation method for solving highly oscillatory Helmholtz equations in polar coordinates. The transverse domain and the governing equations are decomposed into micro and macro domains, allowing for an advantageous modeling orientation. The coupled equations are discretized utilizing a compact finite difference strategy for increased efficiency and radial accuracy.

The numerical method is shown to be asymptotically stable at high-wavenumbers, facilitating effectiveness, reliability, and applicability. An overview of the stability

analysis, including spectral norms bounds, will be presented. Optical beam numerical simulations with a range domain scaling factors reinforce these findings.

Speaker: **Sharon Lanaghan** and **Kristen Stagg**
Institution: California State University, Dominguez Hills
Title: ***Redesigning Calculus I with Standards Based Grading and Active Learning***
Abstract: Despite the importance of Calculus I in STEM studentsÕ path toward graduation, pass rates at CSUDH in the course have typically been low, with only 60.9% of students earning a C or better in years prior to our redesign. Many students lack both content prerequisite skills and 21st century learning skills (critical thinking, creative thinking, communicating, and collaborating) required for success in the course and in their future STEM courses. Our redesign uses standards based grading, active learning and the use of Supplemental Instruction Leaders (SILs) to help students identify and remediate skill gaps. The course offers students multiple ways to interact with content, and gives them opportunities to develop communication and collaboration skills. Initial results suggest that these changes have had a positive impact on student success. In this session, we will describe our redesigned course and its outcomes, including the impact on the STEM Mathematics Pathway at CSUDH.

Speaker: **Junyuan Joanne Lin**
Institution: Loyola Marymount University
Title: ***Algebraic Multigrid for Least Squares Problems on Graphs with Applications to Recommender System***
Abstract: Least squares problems are a large subclass of numerical linear algebra problems that may arise in a multitude of contexts where the matrix depends on a graph. Solutions to these problems are very practical and as scalability becomes a prevalent issue, researchers are working to identify algorithms most appropriate to solve these least squares problem. In this work we investigate the effectiveness of the unsmoothed aggregation AMG (UA-AMG) method and show it's more appropriate for graph-related problems due to its ability to maintain the structure of graphs in the multilevel hierarchy. We also provide experiments comparing conjugate gradient method with and without UA-AMG as a preconditoner on a collection of real-world network topologies to demonstrate how this precondtioner can be used for recommender system.

Speaker: **Anna Ma**
Institution: University of California, Irvine
Title: ***Randomized Kaczmarz for Tensors***
Abstract: When data is large-scale, techniques such as the Randomized Kaczmarz algorithm and Randomized Gauss-Seidel algorithm are advantageous for solving linear systems of the form Ax = y. In this talk, we discuss an extension of the Randomized Kaczmarz algorithm to the setting where large-scale data takes on the form of a multidimensional array. Traditionally, multi-dimensional data, i.e., data in the form of high dimensional tensors, are often unfolded to be treated as a matrix-vector problem. In this work, we seek to preserve the tensor structure of the input data and provide theoretical guarantees for recovering underlying, unknown tensors from linear measurements using a tensorized version of the Randomized Kaczmarz algorithm.

Speaker: **Aisha Najerá**
Institution: RAND Corporation
Title: ***With an eye towards public policy research through a mathematician's lens***
Abstract: Some people are drawn towards science research because they want to have impactful contributions, yet the pursuit of new knowledge is not always the corner stone, but translating the findings to the right audience. This talk will provide: 1) an overview of some of the research questions I have been working on during my time at the RAND corporation, a nonprofit policy think tank, 2) the weaving of math into the problems, and 3) a canvas for communicating the findings. The subjects range from military logistics, cybersecurity, climate change and feminism.

Speaker: **Mahnaz Moradi Nargesi**
Institution: Cal Poly Pomona
Title: ***Convolution Properties of Classes of Analytic and Meromorphic Functions***
Abstract: General classes of analytic functions defined by convolution with a fixed analytic function are introduced. Convolution properties of these classes which include the classical classes of starlike, convex, close-to-convex, and quasi-convex analytic functions are investigated. These classes are shown to be closed under convolution with prestarlike functions and the Bernardi-Libera integral operator. Similar results are also obtained for the classes consisting of meromorphic functions in the punctured unit disk.

Speaker: **Alessandra Pantano**
Institution: University of California, Irvine
Title: ***Building college and STEM pathways for underserved youth by leveraging the mentoring power of undergraduate and graduate students***
Abstract: UC Irvine's Math CEO (Community Educational Outreach) is a transformative afterschool program that leverages the mentoring power of UCI graduate and undergraduate students to inspire underserved youth to pursue college education and a career in STEM, while at the same time fostering math achievement and dispositions needed to persist in STEM pathways. In this talk, we describe the impact of the program on participating mentors and youth.

Speaker: **Anita Penkova**
Institution: University of Southern California
Title: ***Mathematical model and experimentation for measuring the diffusion coefficient of intravitreally injected drugs in ex vivo and in vivo study***
Abstract: Currently, certain retinal diseases are managed by the intravitreal administration of anti-VEGF agents. To study the advantages and limitations of anti-VEGF drugs used to treat retinal disorders, is necessary to predict and measure parameters and properties pertaining to drug transport. One such parameter is the diffusion coefficient. MRI (Magnetic Resonance Imaging) and OCT (Optical Coherence Tomography) techniques were used to measure the experimental diffusion coefficient of various MRI surrogate compounds and fluorescently conjugated drugs. In our previous study, we obtained the diffusion coefficient in the vitreous humor by developing a mathematical model based on these precise experimental measurements. There is a

very good agreement between our mathematical model and experimental data. Our method can be applied to various compounds with different molecular masses, charge and physicochemical properties.

Speaker: **Melike Sirlanci**
Institution: California Institute of Technology
Title: ***Controlling Blood Glucose Levels of Intensive Care Unit Patients***
Abstract: Because of critical health conditions, blood glucose (BG) levels of intensive care unit (ICU) patients show chaotic behavior. However, research has proven that keeping BG levels of these patients in a healthy target range decreases mortality and morbidity in the ICU. For this purpose, we develop a new mathematical mechanistic model that describes the glucose-insulin system in humans in the possible simplest way. Based on real patient data, we then estimate unknown model parameters in a Bayesian framework to obtain the personalized model and then use this model to forecast future BG levels and then to control BG levels in the desired target range.

Speaker: **Felicia Tabing**
Institution: University of Southern California
Title: ***Combining Synesthesia, Mathematics, and Art***
Abstract: Synesthesia is something I realized I may have some years ago when my boyfriend asked me what color 3 was, prompted by a show he heard on the radio. I told him it was pink. I will talk about my efforts to create art by combining mathematics and teaching mathematics, and using colors governed by how the integers are colored in my mind.

Speaker: **Zhanerke Temirgaliyeva**
Institution: University of Southern California
Title: ***Global regularity and long-time behavior of the solutions to the modified 3D Boussinesq equations***
Abstract: This talk addresses the global regularity and long-time behavior of the solutions to the 3D Boussinesq equations with nonlinear damping $\alpha|u|^{\beta-1}u$ ($\alpha > 0, \beta \geq 1$) for the flow of an incompressible fluid with positive viscosity and zero diffusivity.

Speaker: **Sonali Vyas**
Institution: California State University, Fullerton
Title: ***Murder Mysteries and Machine Learning***
Abstract: Data analytics and machine learning is a new and growing field in science and mathematics. The applications are endless, and the accuracy of the machine's learning skills are continuously improving. The goal of our interdisciplinary project is to use Natural Language Toolkit (NLTK) to predict the outcome of Agatha ChristieÕs murder mystery novels. Agatha Christie is a well-known author from the 1920s who earned the title of being the Queen of Mystery. Her books consist of several characters and unexpected plot developments that make her stories unpredictable. We use the NLTK package to discern patterns in Agatha Christie's writings and determine if she is as unpredictable as we have been led to believe. This project has the potential to improve on the processes used in data analytics and the techniques used can be applied to multiple fields.

Speaker: **Chunmei Wang**
Institution: Texas Tech University
Title: ***Primal-Dual Weak Galerkin Finite Element Methods for First-Order Transport Problems***
Abstract: The speaker will introduce a new numerical method for first-order transport problems by using the primal-dual weak Galerkin (PD-WG) finite element method recently developed in scientific computing. The PD-WG method is based on a variational formulation of the modeling equation for which the differential operator is applied to the test function so that low regularity for the exact solution of the original equation is sufficient for computation. The PD-WG finite element method indeed yields a symmetric system involving both the original equation for the primal variable and its dual for the dual variable (also known as Lagrangian multiplier). For the linear transport problem, it is shown that the PD-WG method offers numerical solutions that conserve mass locally on each element. Optimal order error estimates in various norms are derived for the numerical solutions arising from the PD-WG method with weak regularity assumptions on the modelling equations. A variety of numerical results are presented to demonstrate the accuracy and stability of the new method.

Speaker: **Lora Weiss**
Institution: University of California, Irvine
Title: ***Mathematical Modeling of Cancer Stem Cell Enrichment***
Abstract: Tissues are made of different types of cells. Stem cells do not perform any tissue- specific functions but instead serve as a reservoir for other cell types, called "differentiated cells". Cellular processes such as divisions and deaths of stem and differentiated cells are regulated by a complex network of signals, which keeps the tissue stable and healthy. Cancer cells disobey this signaling, which may lead to an unlimited growth of the cell population. In the context of cancer therapies, stem cells have proved to be more difficult to treat than more differentiated cells, so an increasing ratio of stem cells to more differentiated cells over time is undesirable for treatment. This scenario of a faster growth rate of the stem cell population is a phenomenon we call Cancer Stem Cell (CSC) enrichment. The goal of this research was (1) to mathematically study tissue stability under different signaling networks, and (2) to discover which possibilities of cell regulation led to CSC enrichment. This has applications for medical treatment plans, which can screen for the type of cell regulation, determine whether or not CSC enrichment occurs, and design the therapies accordingly.