TUMC 2024 – Abstracts of Contributed Talks

Early Afternoon Talks (1:50-3:05pm)

WTB 133

- (1:50-2:05pm)
  Stian du Preez, Rice University
  Morita Equivalence of Combinatorial Inverse Semigroups with Zero

  In this talk, we explore methods for detecting Morita equivalence of combinatorial inverse semigroups with zero. We investigate how structures such as inverse sub-monoids and the D-relation are preserved under Morita equivalence. Additionally, we identify necessary combinatorial data required to establish this equivalence. Finally, we apply these tools to analyze the Morita equivalence of inverse hulls of certain shift spaces, a result with implications for the study of C*-algebras.

- (2:10-2:25pm)
  Chloe Povey-Rowe, Baylor University
  Generalizing Chein's M(G,2) Loops via a Modified Cayley-Dickson Process

  This talk presents a construction that generalizes Chein's M(G,2) Moufang loop using a modified Cayley-Dickson process, incorporating an antiautomorphism and a central element. The resulting structure is a closed magma, whose properties reduce to M(G,2) under specific conditions, while other modifications lead to the formation of various established loops.

- (2:30-2:45pm)
  Landon Chambers, St. Edwards University
  A p-subgroup in the Nottingham Group

  We consider a type of formal power series where the coefficients belong to a field, the constant term is zero, and the coefficient of the linear term is one. Under the action of composition, these particular power series form a group called the Nottingham group. Our main contribution is the statement and proof that a specific subgroup of the Nottingham group over an arbitrary finite field is a p-group. As a p-group, this subgroup must contain a tower â€“ a hierarchical structure of p-subgroups. Practitioners who utilize mathematical models represented by the composition of power series, such as feed-forward neural networks, can use these results to better understand the algebraic structure of their models.

- (2:50-3:05pm)
  Maggie (Thi Mai Khoi) Ha, University of Houston Downtown
  Group Classification up to Isomorphism of Groups up to Order 15

  While the results are known, our approach/organization to obtaining the results is different from the approach found in the literature. For the nontrivial orders, we repeatedly rely on the notorious construction of semidirect products. From orders 1 to 15, we grouped them into six nontrivial categories. (1) Groups of prime order; (2) Groups of prime power order; (3) Groups of doubled prime order; (3) Groups of order 15; (4) Groups of order 8; (6) Groups of order 12. We obtain that, up to isomorphism, (1) there exists a unique group of each of the orders 1,2,3,5,7,11,13,15; (2) two groups of each of the orders 4,6,9,10,14. (3) five groups of each of the orders 8 and 12. That is altogether 28 groups of order up to 15. The number of groups used refers to the number of isomorphism classes of groups.

WTB 136

- (1:50-2:05pm)
  Jacob Gomez, Angel Moreno, and Alicia Scarlett, Sam Houston State University
  Dishware Optimization

  The total cost associated with reusable dishware is the sum of the upfront cost of purchasing the dishes and the reoccurring cost of cleaning the dishes. We show that the minimum cost to the consumer is twice the geometric mean of the upfront and cleaning costs. We conclude with an analysis of our model and a cost comparison with disposable dishes.

- (2:10-2:25pm)
  Yasmine Soto, Southwestern University
  Spinning Stories: A Mathematical Model of Rumor Dynamics

  Without meeting a person, we might already have an idea of what they could be like due to their reputation from others. However, that reputation can easily shift due to a rumor especially if the rumor is known by many people. We present a preliminary model of a simulation of the spread of a rumor by initially assuming that one person initiates it and that the rumor can only be spread one-to-one. We will also be discussing additional changes in the model based on different assumptions.

- (2:30-2:45pm)
  Christopher Garza and Leo Schoch-Spana, Southwestern University
  Developing Models for Lung Cancer in the United States

  We present initial models of lung cancer within the United States. Numerous factors are taken into account which we predict contribute to the fluctuation of the number of cases over the years. These factors include but are not limited to: poverty, smoking, usage of gas appliances in homes, etc. This was all collected using published data mostly from the CDC. We analyze the relationships between these factors and the rates of lung cancer.

- (2:50-3:05pm)
  Isabella Robinson, Southwestern University
  Modeling Monarch Butterfly Populations

  In the past several decades, Monarch butterfly populations have been on the decline due to factors like natural predators, pesticides, parasites, as well as man made threats like urbanization and vehicle collisions, since milkweed is commonly planted by roadsides. Using Leslie Matrices, we model the population of Monarchs in its four life stages - larvae, chrysalis, and adult butterfly and examine sensitivity to parameter values.

WTB 137

- (1:50-2:05pm)
  Kyle Earp, Tarleton State University
  Improve Single Point Estimates for ODE Models of Disease Spread

  Classical models of disease outbreaks rely on systems of nonlinear ordinary differential equations. ODE models have been widely successful and are credited with saving millions of lives worldwide. However, ODE models involve parameters that are often poorly understood and difficult to infer from limited and noisy data. This is especially problematic for rare, novel, or neglected diseases with unreliable reporting mechanisms. While some parameters can be deduced from biological or social facts, many must be inferred from data. Traditional least-squares point-estimates are fragile when applied to noisy data common in disease modeling. Bayesian inference replaces fragile point-estimates with posterior distributions that are more robust against data quality issues. Whereas point-estimate models produce a single outbreak forecast, Bayesian models generate an ensemble of forecasts through repeatedly sampling model parameters from their posterior distributions and numerically solving the resulting ODE. These multiple forecasts can be pooled and statistically analyzed at each time step (min, max, mean, etc) to give insight into potential outbreak scenarios (best-case, worst-case, most likely, resp). Additionally, there might exist different parameter sets that produce similar least-squares values. In these cases it can be unclear what the most correct parameter set is. By using prior distributions that include these single point-estimates, we can allow Bayesian methods to determine the most likely values for unknown parameters by analyzing the posterior distributions generated by the Bayesian model. This project aims to create well-functioning ODE models using a new mathematical idea called amortized Bayesian inference implemented in the BayesFlow Python library. This exciting new tool was created in 2020 to help fight Covid-19 and other common diseases. This project will enhance the BayesFlow library to compensate for data quality issues and provide the improved models epidemiologists need to effectively fight NTDs, and develop techniques for handling systems where single point-estimates are not unique.

- (2:10-2:25pm)
  Mason Bane, Tarleton State University
  Simulating Left Atrial Arrhythmias with an Interactive NN-*body Model*

  Supraventricular Tachycardia (SVT) arises when the heart's atria beat too quickly or irregularly compared to the ventricles. While SVT is not immediately life-threatening, it can lead to serious complications such as strokes, heart attacks, and heart failure. The primary treatment for SVT is catheter ablation. This procedure involves an electrophysiologist creating a 3D map of the heart and using radiofrequency (RF) catheter ablation to treat problematic tissue. Despite advances in the field, there are still significant gaps in our understanding of SVT triggers and the optimal ablation sites, particularly in conditions like atrial fibrillation (AF).

  To address these gaps, our team has developed a real-time, interactive model that simulates the left atrium at the individual muscle level. This digital twin allows users to test and refine ablation strategies outside the operating room by importing patient data from CT scans and electrocardial mapping. Our approach enhances SVT research and treatment planning without risking patient safety. This innovative work has the potential to revolutionize cardiac care and significantly improve patient outcomes.

- (2:30-2:45pm)
  Scott Whitman, University of Louisiana at Lafayette
  Using Numerical Optimization to Create Tiling Schemes for Attaining kk-*Coverage in Wireless Sensor Networks*

  Attaining coverage of a region is one of the main goals of any Wireless Sensor Network (WSN) design. It is known that the placement scheme that uses the fewest sensors to cover the plane is to break up the plane into a regular hexagonal tiling and cover each tile by a sensor in the middle of the tile. A natural way to extend this to k-coverage by placing k sensors to cover each tile. Prior work in this direction has generally been done by starting with a region in which to place the k sensors, then choosing a tile based on that. Here, we use numerical optimization techniques to find the optimal tiling for any polygonal deployment region. This allows for the use of fewer sensors to k-cover a region within the same placement constraints. Based on these tiles we use numerical optimization to obtain less restrictive deployment regions that still cover those tiles. Based on these deployment regions we have a conjecture for the best deployment region for sensor density. Our comparisons to prior deployment schemes by area show that our methods provide better sensor densities.

- (2:50-3:05pm)
  Jamie Mahowald, University of Texas at Austin
  Analysis of in-context operator networks

  Neural networks have showed great promise for producing accurate numerical solutions differential equations, provided insufficient data. This work builds on an initial in-context operator network (ICON) model that learns to map conditions to quantities of interest for various differential equation types. Key developments include:

    - Extending ICON to generalize to new types of higher-dimensional and higher-order PDEs partial differential equations (PDEs) not seen during training, including a 2D, second-order linear PDE,
    - Developing data generation techniques for these more complex PDEs using Gaussian processes and finite difference methods,
    - Evaluating model performance on both in-distribution and out-of-distribution PDE types,
- Distilling large numerical datasets into smaller sets on which the model achieves similar performance.

Results demonstrate ICON's ability to learn and generalize across various differential equation types, with some limitations on higher-dimensional problems. The research also explores potential applications, including an interactive system for users to input differential equations and receive numerical solutions.

WTB 235

- (1:50-2:05pm)
  Cole Thomson, Southwestern University
  Analysis of Music retention and popularity on Billboard's 100

  Billboard charts the best performing music based on physical sales, radio air time, and streaming data, compiled by Luminate, an entertainment journalistic and data science organization. We present a preliminary analysis of the length of time popular songs stay popular on the Billboard’s Top 100 over the years, how often the artists that produce these songs get their work on the chart, and the relationship between the highs a song reaches vs how long that song remains relevant. Our data spans from 1959, the year after Billboard’s first records online, to 2020, and will be subdivided into years and months, due to the overwhelming amount of data.

- (2:10-2:25pm)
  Lucas Rodriguez, University of Dallas
  Algorithmic Randomness of the Dirichlet Problem of the Upper Half-Plane

  There has been a movement to characterize different notions of algorithmic randomness with almost-everywhere convergence theorems from analysis. In harmonic analysis, the Dirichlet problem asks for a harmonic function u on a domain Î© that is equal in a sense to a function f on the boundary of Î©. Considering Î© as the upper half of RÂ^2, the Poisson integral of an L1-computable function is a solution to the Dirichlet problems of the upper half plane. However, it is only a partial solution because the Poisson integral only converges to f on the real line for almost all x. Inspired by the characterization of randomness by the Lebesgue differentiation theorem, we explore what kind of randomness is characterized by the Dirichlet problem of the upper half plane.

- (2:30-2:45pm)
  Aaron Puente, University of Texas Rio Grande Valley
  Analytical & Numerical Solutions to Fractional PDEs via a Wright-type Transformation

  This project investigated a new approach to solving fractional partial differential equations (FPDEs) using a Wright-type transform. The Wright-type function is generated from a stochastic process and serves as the kernel in the integral transform. We demonstrate a robust numerical method for computing these integral transforms efficiently and with high accuracy. We then demonstrate how these numerical integral transforms can be coupled with traditional numerical techniques for solving integer-order partial differential equations to solve FPDEs. Furthermore, we will also present analytical approaches for FPDEs in cases that allow for it.

- (2:50-3:05pm)
  Alessandra Martinez and Mat Taylor, University of Texas Rio Grande Valley and University of Texas at Tyler
  Integer Partitions and Their Tableaux

  A partition of a positive integer n is any non-increasing sequence of positive integers whose sum is n. A partition can be represented as a collection of boxes arranged in left-justified rows of weakly decreasing length, called a Young diagram. When each box is labeled bijectively with numbers from 1 to n such that the labels are strictly increasing along both the rows and columns, the diagram becomes a standard Young tableau. The number of standard Young tableaux is dependent on the shape of the Young diagram. The well-known hook length formula computes the number of standard Young tableaux of any partition shape; however, some shapes yield simpler formulas. We will present new formulas for the number of standard Young tableaux for partitions with specific part restrictions. We also investigate the one-to-one correspondence between involution permutations and standard Young tableaux.

WTB 236

- (1:50-2:05pm)
  Thomas "Emiah" Carpenter, Midwestern State University
  Reflection of a Line across a Differentiable Function

  Inspired by the geometric interpretation of function inverses as reflections across the line y = x, we generalize this concept to reflect a linear function (the subject) across any differentiable function (the mirror). This reflection yields a parametric equation, referred to as the image. Through this framework, we explore the asymptotic behaviors and limiting properties of the image. The most interesting properties arise when our mirror is a conic section.

- (2:10-2:25pm)
  Melody Martinez, Sul Ross State University
  Designing Mathematics Activities for a Mobile Setting

  Sul Ross State University has had a Mobile STEM van for the last few years to bring the love of science and mathematics to various K-12 schools and programs in our region. The activities of the Mobile STEM Van this far have been limited to science and technology activities and have had a lack of engagement for students to learn the mathematical perspectives of STEM. To address this, we researched various engaging activities that encourage students to explore mathematics from new perspectives. Each activity is rooted in graph theory, featuring concepts such as the two-color and four-color problems, the four-cube problem, Eulerian graphs, number mazes, and mathematical origami. Each topic is presented uniquely, complete with a historical context. Many students shy away from mathematics in STEM due to its perceived difficulty. Our goal is to help them discover the artistic side of mathematics, revealing its beauty and creativity.

- (2:30-2:45pm)
  Ethan Massey, Dallas College - Richland Campus
  Exploring Eulerian and Hamiltonian Paths in Graph Theory: Applications in Optimization and Combinatorics

  In this paper, we explore Eulerian and Hamiltonian paths, looking at their structures and their use in optimization and combinatorics. We also describe a system we built called Alytiqcon, a user-friendly tool that determines the presence of a Hamiltonian or Eulerian path from a user-inputted graph. Alytiqcon supports various types of graphs, such as directed, undirected, weighted, and unweighted graphs, allowing users to input complex or simple structures. Combining computer science, advanced heuristics, and approximation techniques, Alytiqcon applies sophisticated graph theory algorithms to evaluate a graph's structure, providing a thorough path detection tool.

  We'll begin by examining Eulerian paths, giving the basic elements a graph needs to have one. We'll explain the Eulerian path algorithms that Alytiqcon uses, like Fleury's and Hierholzer's algorithms, and show their applications in optimization and combinatorics. For a Hamiltonian path, we'll outline the necessary criteria, discuss the algorithms Alytiqcon uses, such as backtracking approaches and dynamic programming methods, and discuss their applications in optimization and combinatorics.

  Finally, we'll take a closer look at Alytiqcon itself. We'll share various case studies and real-world applications and discuss challenges and future directions. Our main goal is to apply our knowledge of Eulerian and Hamiltonian paths and various algorithms; we'll demonstrate how these concepts are used in different scenarios and how Alytiqcon can help provide more effective and efficient solutions to these problems.

- (2:50-3:05pm)
  Graeme Reinhart, Baylor University
  A Note on Smith Numbers and Fermat's Two Squares Theorem

  In 1855, Henry John Steven Smith (1826-1883), the Savilian Chair of Geometry at the University of Oxford, gave a proof of Fermat's two squares theorem which states that only prime numbers of the form 4n+1 can be written (uniquely) as the sum of two squares of positive integers. Smith's proof is elementary in the sense that it is comprehensible to those with only a background in the theory of determinants. Smith proved that if p=4n+1 is prime, then there exists a unique positive integer x_0 in the interval (1,(p-1)/2) satisfying the quadratic congruence (x_0)^2=1 mod p. This number x_0, which we call the Smith number for the prime p, is instrumental in Smith's proof and leads to a palindromic continuant representation of p. In this talk, we develop properties of Smith numbers and, in particular, we give a necessary and sufficient condition for a positive integer to be the Smith number of some prime.

Late Afternoon Talks (3:45-5:00pm)

WTB 133

- (3:45-4:00pm)
  Logan Greenland, Texas State University
  Connecting Categorical and Topological Limits

  Oftentimes in mathematics, when two objects have the same name, they may be special cases of each other. When one starts to study category theory, they will come across the notion of limits and colimits, with limit being a very familiar term from Analysis and Topology, but the categorical presentation seems far from the delta-epsilon definition we know and love. This presentation will showcase the seemingly convoluted connection and serve as some introduction to category theory for those who haven't seen it before!

- (4:05-4:20pm)
  Ronny Ferreira, Dallas College
  The Fibonacci Sequence in Linear Algebra

  Inserting the Fibonacci sequence as the elements of a matrix produces interesting patterns when analyzed as a system of equations. We'll discover the Fibonacci matrix. the powers of the golden ratio, and work towards Cassini's and Catalan's identities.

- (4:25-4:40pm)
  Haily Martinez-Aguirre, University of Texas Rio Grande Valley
  Congruence properties of lecture hall partitions

  In 1997, Bousquet-Melou and Erikkson proved a finite version of Euler’s â€œodd = distinctâ€ partitions theorem and thus discovered lecture hall partitions. For positive integers n and m, this finite version can be stated as follows: p(nâ”,odd parts,none larger than 2m-1)=LH_m(n), where LH_m denotes the lecture hall partitions of n with length m. This talk will discuss families of Ramanujan-like congruences in arithmetic progression for the lecture hall partitions. For example, for all integers k>0, LH_3 (15k-1)â‰¡0(mod 5), LH_4 (105k-1)â‰¡0(mod 7), LH_3 (3465k-7)â‰¡0(mod 11). Our results are similar to congruences for p(n,d), the function enumerating the partitions of n into at most d parts established by Kronholm in 2005.

- (4:45-5:00pm)
  Mrinal Kanti Roychowdhury (Faculty), University of Texas Rio Grande Valley
  Constrained Quantization and Conditional Quantization

  Constrained quantization for a Borel probability measure refers to the idea of estimating a given probability by a discrete probability with a finite number of supporting points lying on a specific set. The specific set is known as the constraint of the constrained quantization. A quantization without a constraint is known as an unconstrained quantization, which traditionally in the literature is known as quantization. Constrained quantization has recently been introduced by us (Pandey and Roychowdhury).

  With the introduction of constrained quantization, quantization now has two classifications: constrained quantization and unconstrained quantization. Further, we have introduced another new idea in quantization which is known as conditional quantization in both constrained and unconstrained cases. After the introduction of constrained quantization, and then conditional quantization, the quantization theory is now much more enriched with huge applications in our real world.

WTB 136

- (3:45-4:00pm)
  Jadyn Rhodes-Cruse, Southwestern University
  Comparing Maternal Mortality

  We present preliminary analyses of trends of maternal mortality since 2000 for various countries with differing economic stata. We consider factors such as literacy rates of adults 15+, poverty headcount ratio at national poverty line, % population female, and prenatal care.

- (4:05-4:20pm)
  Dhwani Chandi, St. Mary's University
  Climate Applications in Math

  The integration of climate applications into the mathematics curriculum, particularly at the college undergrad level, bridges the gap between abstract mathematical concepts and real-world applications of math in climate. This project contributes to the creation of a book titled "Climate Applications for the College Mathematics Classroom," which aims to enrich traditional math courses with climate-related problems. The essence of this project is to provide educators with a resource that allows them to integrate climate applications into their curriculum seamlessly, without the need to rebuild their entire course structure. Undergraduate students often encounter resources that are either too simplistic [1] or excessively advanced [2, 3], with the latter often being written in a language more suited to graduate-level studies. There is a noticeable gap in resources specifically designed for traditional mathematics courses, which often have very few climate applications [4, 5]. This distinction creates a barrier to understanding and applying mathematical concepts to climate science, a field that is becoming increasingly important in the context of global environmental changes. This project identifies a niche for curriculum materials that can be periodically incorporated into standard math courses, enhancing the learning experience by connecting mathematical theories with practical climate-related applications.

- (4:25-4:40pm)
  Allegra Simmons, University of Dallas
  A Delayed and Stochastic Model for Prion Disease Dynamics and Spreading

  Prion diseases are a type of neurodegenerative disorder caused by the misfolding of normal cellular proteins into a toxic form. This misfolding results in neuronal stress, potentially leading to cell death, and activates the unfolded protein response (UPR), a mechanism that slows protein translation. We developed both a time-delayed and stochastic differential equation model that captures how the UPR impacts the spread of these toxic proteins.

  In this talk, I will explain the construction of the model, discussing its key features, including stability and bifurcation analyses, which present important insights into disease persistence, extinction, and the emergence of periodic toxic protein concentrations. Finally, I will share simulation results that validate our theoretical predictions.

- (4:45-5:00pm)
  Humberto Buenrostro, St. Mary's University
  Paired Sample Designs in Drug Research: Effects on Statistical Outcomes and Visualization Challenges

  This study looks at how paired sample designs, like paired feeding, help control variables such as appetite when testing drug effects on nutrient absorption. Paired feeding ensures weight changes are due to nutrient absorption and not increased appetite, making the results more accurate. The study also explores how bounding statistical distributions, like uniform and exponential, affects key metrics such as variance, t-scores, and p-values, and how it complicates 3D visualizations. Bounding reduces variance, raises t-scores, lowers p-values, and increases the chance of Type I errors. Although paired designs improve the reliability of results, they also make visualizing data harder and increase the risk of false positives, which requires careful interpretation.

WTB 137

- (3:45-4:00pm)
  Nathan Collins, Sam Houston State University
  Numerical Integration Using Polynomial Regressions

  Numerical integration is an important tool for solving integrals when an anti-derivative cannot be found. Approximation techniques, such as the Trapezoidal rule, Simpson's rule, or Boole's rule find solutions to integrals through computation. In this paper, we outline a family of techniques for numerical integration using polynomial regressions of sampled points from the function and derive the error bound for the linear case.
- (4:05-4:20pm)
  Ben-Oni Spradlin and Luis Villanueva, University of Texas Rio Grande Valley
  *A Preliminary Mathematical Model of Differential Susceptibility to Amyloid-*β

  The peptide, Amyloid Beta (AÎ²), is known to play a critical role in the onset of Alzheimer's Disease. It exists in a variety of conformations, including monomers, oligomers, and fibrils. Of these forms, oligomers and fibrils are particularly toxic to the brain, exhibiting varying degrees of toxicity. Factors such as production, clearance, transport, internalization, externalization, and aggregation can lead to changes in concentrations of these species affecting neuronal health in different regions, namely the neocortex, cerebellum, and hippocampus. In this Presentation, we build a mathematical model focused upon differential susceptibility and key AÎ² species to describe Alzheimer's progression.

- (4:25-4:40pm)
  Oluwatobiloba Lawuyi, Prairie View A&M University
  Survival Analysis in Cybersecurity: Predicting Time to Breach

  This work focuses on applying survival analysis to cybersecurity, specifically predicting the time to breach a system. Survival analysis is a statistical method used to predict the time until an event occurs. In this context, the event is a cybersecurity breach. This work will explore how survival analysis can be used to estimate the time it takes for a system to be breached.

- (4:45-5:00pm)
  Md Rafiul Islam (Faculty), University of the Incarnate Word
  Fracture Risk in Diabetic Hispanic Men: A Study from South Texas

  Diabetes mellitus (DM) is associated with increased fracture risk due to its effects on bone health. This study examines fracture prevalence among diabetic and non-diabetic men over 50 in San Antonio, Texas, using electronic medical records from 26,510 male patients collected between 2012 and 2022. Fracture prevalence was significantly higher in diabetic men (9.7%) compared to non-diabetic men (5.0%). Logistic regression analysis revealed that longer duration of diabetes significantly increased fracture risk, while HbA1c levels showed a negative association, suggesting complexities in fracture mechanisms. These findings emphasize the need for tailored fracture prevention strategies in diabetic Hispanic men. Future research should consider additional factors such as comorbidities and medication use to better understand fracture risk in this population.

WTB 235

- (3:45-4:00pm)
  Lohit Jagarapu, University of Texas at Austin
  Computational Topology in Computer Vision: A view and current problems

  Topology is a fundamental way of understanding a space. In graphics and computer vision, one often works over understanding and processing 3D meshes representing surfaces. Topology is a promising novel tool being used to study such constructions, especially in relation to noise-tolerance. I will introduce persistent homology, a mainstay of computational topology, and current problems in the area that are being explored by the research group I am part of.

- (4:05-4:20pm)
  Chloe Povey-Rowe, Baylor University
  Dissipative First Order Differential Operators with Non-Local Point Interactions Part I

  In this talk, I will discuss dissipative operators of the form id/dx+V, where V is a bounded dissipative potential. Besides V, there are two additional sources contributing to the dissipativity of the system: (i) dissipative boundary conditions and (ii) so-called non-local point interactions. Mechanism (ii) is less standard and leads to interesting new problems, even in the first-order case. I will discuss necessary and sufficient conditions for the operators to be maximally dissipative and results on the spectrum of these operators. This is joint work with Christoph Fischbacher, Danie Paraiso, and Brady Zimmerman.

- (4:25-4:40pm)
  Danie Paraiso, Baylor University
  Dissipative First Order Differential Operators with Non-Local Point Interactions Part II

  In this talk, I will discuss dissipative operators of the form id/dx+V where V is a bounded dissipative potential. Besides V, there are two additional sources contributing to the dissipativity of the system: (i) dissipative boundary conditions and (ii) so-called non-local point interactions. I will discuss how the spectrum of the operators with non-local point interactions compares to that one without. Moreover, I will address the possibility of choosing the non-local point interaction in such a way that it generates a real eigenvalue even ifÂ VÂ is very dissipative, which corresponds to one special state for which the energy is preserved. This is joint work with Christoph Fischbacher, Chloe Povey-Rowe, and Brady Zimmerman.

- (4:45-5:00pm)
  Curtis Wesley (Faculty), LeTourneau University
  A Friendlier Way to Teach the Method of Undetermined Coefficients in Differential Equations

  The standard method of producing the correct form of the particular solution in the Method of Undetermined Coefficients is oftentimes confusing for students. It is filled with multiple cases with lists of possible particular solution forms which lead to inevitable frustration for the teacher and students alike. In this presentation, I will show you an easier and friendlier way to find the correct form of the particular solution.

WTB 236

- (3:45-4:00pm)
  Emily Payne, University of Texas Rio Grande Valley
  A Generalization of Franklin's Partition Identity and a Beck-Type Companion Identity

  Euler's classic partition identity states that the number of partitions of n into odd parts equals the number of partitions of n into distinct parts. We develop a new generalization of this identity, which yields a previous generalization of Franklin as a special case. We also prove an accompanying Beck-type companion identity.

- (4:05-4:20pm)
  Ren Watson, University of Texas at Austin
  Results Related to Parity in Fixed-Perimeter Partitions

  In 2016, Straub proved that Euler's classic partition identity holds true for partitions with largest hook (perimeter) n. This inspired further study of the relationship between classical partitions and fixed perimeter partitions. We first prove and generalize the fixed-perimeter analogue of Andrews' S-T Theorem and demonstrate its usefulness in proving fixed perimeter partition inequalities. We extend the study of parity bias inequalities, first introduced by Kim, Kim, and Lovejoy in 2020, to the fixed perimeter setting and show using combinatorial methods that fixed perimeter analogues of many classical parity bias results can be proven and generalized. We also extend these methods to proving similar inequalities for the fixed perimeter analogues of PED and POD partitions. We further develop recursive formulas for the number of perimeter n partitions with odd parts distinct and even parts unrestricted and with even parts distinct and odd parts unrestricted.

- (4:25-4:40pm)
  Duc Van Khanh Tran, University of Texas at Austin
  On Sums of Practical Numbers and Polygonal Numbers

  Practical numbers are positive integers n such that every positive integer less than or equal to n can be written as a sum of distinct positive divisors of n. In this paper, we show that all positive integers can be written as a sum of a practical number and a triangular number, resolving a conjecture by Sun. We also show that all sufficiently large natural numbers can be written as a sum of a practical number and two s-gonal numbers for s larger than 3.

- (4:45-5:00pm)
  Miguel Gonzalez-Carriedo, University of North Texas
  Exploring Complex Base Number Expansions and Fractals

  A renowned mathematician, Dr. Bertrand Russell, once said, “Mathematics, rightly viewed, possesses not only truth but supreme beauty.” What did he mean by this? "Fractals" are objects that exhibit self-similarity, appearing similar regardless of how much they are scaled up or down. This phenomenon can be found in nature, art, and mathematics. In our talk, we will explore how these fractals are connected to revolving sequences of Gaussian integers, which are expressions of complex numbers using complex bases. We will see how plotting these different revolving sequences creates fractals that reveal the beauty and interconnectivity of mathematics.