ABSTRACTS

CONTENTS

PLENARY SPEAKER

Plenary Speaker: **Beatrice Riviere**(riviere@rice.edu)
Rice University

Title: "Numerical Solution of Cahn-Hilliard Navier-Stokes Equations"

Abstract: Modeling multicomponent flows in porous media is important for many applications relevant to energy and environment. Advances in pore-scale imaging, increasing availability of computational resources, and developments in numerical algorithms have started rendering direct pore-scale numerical simulations of multiphase flow in pore structures feasible. This talk presents recent advances in the discretization of phase-field models for systems of two-phase flows. Spatial discretization is based on interior penalty discontinuous Galerkin methods. Time discretization is either fully implicit or a decoupled splitting approach. Both theory and application of the proposed methods to model flows in porous structures are discussed.

BEST ONLINE PRESENCE PRACTICES WORKSHOP

Martha Asare (martha.asare01@utrgv.edu)
The University of Texas Rio Grande Valley
Kristen Hallas (kristen.hallas01@utrgv.edu)
The University of Texas Rio Grande Valley
Ilse Moya (ilse.moya01@utrgv.edu)
The University of Texas Rio Grande Valley

If you need a website, want to grow your LinkedIn profile, or refresh your resume/CV, check out this student-led workshop. The "Best Online Presence Practices" (BOPP) is a hands-on professional development workshop for students to create and/or improve their resume/CV, your LinkedIn profile, your portfolio website, or all three. By the time you leave the workshop, you'll have an easy-to-update website, a plan to grow on LinkedIn, and a resume ready for all your applications.

1. FACULTY MATHEMATICS TALKS

Reza Ahangar (reza.ahangar@tamuk.edu)
Texas A&M University Kingsville

Title: "Feynman - Bogdan Path Integral"

Abstract: In 1940, R.P. Feynman attempted to find a mathematical representation to express quantum dynamics of the general form of double-slit experiment. His intuition on several slits with several walls in terms of Lagrangian instead of Hamiltonian resulted in a magnificent work. It was known as Feynman Path Integrals in quantum physics, and a large part of the scientific community still considers them as a heuristic tool that lacks a sound mathematical definition. This paper aims to refute this prejudice, by providing an extensive and self-contained description of the mathematical theory of Feynman Path Integration, from the earlier attempts to the latest developments, as well as its applications to quantum mechanics. About a hundred years since the beginning of modern physics, it was realized that light could in fact show behavioral characteristics of both waves and particles. In 1927, Davisson and Germer demonstrated that electrons show the same dual behavior, which was later extended to atoms and

molecules. We shall follow the method of Bogdon integration with some modifications to construct a generalized Bochner-Lebesgue-Steilltjes integral of the form $\int u(f, \mathrm{d}\mu)$ where u is a bilinear operator acting in the product of Banach spaces, f is a Bochner summable function, and μ is a vector valued measure. We will demonstrate that the Feynman Path Integral is consistent and can be justified mathematically with Bogdan integration approach. A general form of this theory, called Bochner-Lebesgue Steiltjes Integration, will be presented.

Aden Ahmed (aden.ahmed@tamuk.edu)
Texas A&M University - Kingsville
Title: "Taking Chances: The Analysis of Simplified Parcheesi"
Abstract: Parcheesi is an example of a two-player, strictly competitive game of perfect information with chance moves. This game has only two possible outcomes that we will denote by W (a win for Player I and a loss for Player II) or L (a loss for Player I and a win for Player II). In such games, the motivation of a rational player is to maximize the probability of winning. Parcheesi is played between Player I (White) and Player II (Black) on a $(2m + 1)$ by n board. The central cell in the first column of the board is shaded. The winner is the first to reach the shaded square following some prescribed routes and rules. We will restrict our attention to the 3×2, 3×3, and 5×2 board games. For the first two cases, we will briefly share the solutions. A complete analysis of the third case will be presented. A conjecture on the $(2m + 1)$ by 2 will conclude the presentation.

Andrew Alaniz (andrew.alaniz01@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "On the Irregularity Function of a Local Geometric Langlands Parameter"
Abstract: Let G be a complex algebraic group. In the geometric Langlands program, local Langlands parameters are formal flat G-bundles. In this talk I will discuss a combinatorial problem which arises when trying to minimize the irregularity function of a formal flat G-bundle modified by a representation of the Lie algebra of G.

Andras Balogh (andras.balogh@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Numerical Stationary Solutions for a Viscous Burgers' Equation"
Abstract: The Viscous Burgers equation with zero Neumann boundary conditions has been shown to exhibit false (numerical) stationary solutions due to finite precision arithmetic. In the current work we use a relaxation Runge-Kutta method that has monotony preserving property regarding the energy and it also conserves linear invariants of the system.

Dambaru Bhatta (dambaru.bhatta@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Thermo-solutal convection in a horizontal porous layer"
Abstract: Here we present Soret and Dufour effects representing the coupled phenomena between heat and mass due to thermo-solutal convection in a horizontal porous layer. Conservation of mass, Darcy momentum equation, energy equation for the temperature and concentration equation for the solute constitute the governing system in this case. After obtaining the solutions of the basic state system, we perform linear stability analysis on the perturbed system using normal mode approach to obtain critical thermal Rayleigh number and wave number. Marginal stability curves are presented for various Soret and Dufour numbers. We also present 2D convection cells for the for the temperature variable.

Roger Knobel (roger.knobel@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "On the Periodic Behavior of Eigenvalues in Special Jacobi Matrices"
Abstract: Discontinuous coefficients are known to produce a periodic behavior in the eigenvalues of the Sturm-Liouville equation. In this talk a similar phenomenon is observed in the eigenvalues of a matrix formed by discretizing the Sturm-Liouville equation. This behavior is explained by a linearization of the matrix eigenvalues as functions of the matrix entries. An inverse problem of using the observed period behavior to reconstruct the matrix

is then discussed.

Michael Lindstrom (mike.lindstrom@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Continuous Semi-Supervised Nonnegative Matrix Factorization"
Abstract: Nonnegative matrix factorization (NMF) is an unsupervised method to detect topics within a corpus. It amounts to an approximation of a nonnegative matrix as the product of two nonnegative matrices of lower rank. In certain applications it is desirable to extract topics and use them to predict quantitative outcomes. In this talk, we show how NMF can be combined with regression on a continuous response variable through a weighted penalty function. We test our method on synthetic data and on real data coming from Rate My Professors reviews to predict an instructors rating from their comments. When used as a dimensionality reduction method, the method performs better than doing regression after topics are identified and it retrains interpretability.

Oleg Musin (oleg.musin@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Karamata inequality and minimum energy configurations"
Abstract: We consider the Karamata (majorization) inequality and minimums of the majorization (M-sets) for f-energy potentials of m-point configurations in a sphere. In particular, we discuss the optimality of regular simplexes, describe M-sets with a small number of points, define spherical f-design and study their properties. Then we consider relations between the notions of f-designs and M-sets, τ-designs, and two-distance sets.

Michael T. Muzheve (michael.muzheve@tamuk.edu)
Texas A&M University - Kingsville
Title: "Packing 3-vertex paths in vertex envelopes"
Abstract: We prove a result giving a necessary and a sufficient condition for the existence of a Λ-factor in the vertex envelope of a connected planar graph G. We then identify classes of graphs whose vertex envelopes have a Λ-factor, showing in the process that there are 2-connected cubic planar graphs that have a perfect matching, a 2-factor, and a Λ-factor that can be found in polynomial time.

Marlio Paredes (marlio.paredes@correounivalle.edu.co or marlio.paredes@utrgv.edu)
Universidad del Valle (Colombia) and University of Texas Rio Grande Valley
Title: "Mathematical modeling to study the dynamics of a methamphetamine market"
Abstract: Methamphetamine is one of the most widely distributed psychostimulants in the world. Despite measures taken by different countries, neither the general use of methamphetamine nor the repetition frequency of users has decreased in the last decade. Methamphetamine induces abuse and dependence because of it acts on the central nervous system and temporarily stimulates the brain. Methamphetamine volatilely combines an euphoric increase in dopamine release with adverse effects over all organs in the human body. The consumption of methamphetamine is a public health problem in different countries of the world and mainly, in our region, there is a problem not only of consumption but also of trafficking from Latin America to the United States. We examine, through two compartmental models, the dynamics of a hypothetical methamphetamine market, seeking to understand the interaction between users, gangs, sellers, and cartels.
Joint work with:
Isnardo Arenas, Universidad Militar Nueva Granada, Colombia, isnardo.arenas@unimilitar.edu.co
Paula Andrea Gonzalez-Parra, Universidad Autonoma de Occidente, Colombia, pagonzalez@uao.edu.co
Anuj Mubayi, IQVIA, Associate Principal, USA, anujmubayi@yahoo.com

Muhammad Mohebujjaman, Ph.D. (harag@tamiu.edu)
Texas A&M International University
Title: "Numerical Analysis and Testing of Decoupled Algorithms for Reaction-Diffusion N-Species Competition Model with Harvesting/Stocking Effort"
Abstract: We propose, analyze and test two novel fully discrete decoupled linearized algorithms for a nonlinearly coupled reaction-diffusion N-species competition model with harvesting or stocking effort. The time-stepping

algorithms are first and second order accurate in time and optimally accurate in space. Stability and optimal convergence theorems of the decoupled schemes are proved rigorously. We verify the predicted convergence rates of our analysis and efficacy of the algorithms using numerical experiments and synthetic data for analytical test problems. We also study the effect of harvesting or stocking and diffusion parameters on the evolution of species population density numerically and observe the co-existence scenario subject to optimal harvesting or stocking.

Zhijun Qiao (zhijun.qiao@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "On non-traveling wave type of peakon solutions"
Abstract: In this talk, we will present new type of peakon solutions of partial differential equations, called rogue peaked solitons (peakon) provided with an non-traveling wave. Some linear and nonlinear models are taken to illustrate the rogue peakon solutions. This is the joint work with Zhenteng Zeng.
Joint work with:
Zhenteng Zeng, MS student, zhenteng.zeng01@utrgv.edu, The University of Texas Rio Grande Valley

Zhijun Qiao (zhijun.qiao@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "UTRGV graduate programs in Math, Stats, and Interdisciplinary STEM areas"
Abstract: In this talk, I will introduce three UTRGV graduate programs, two masters and one doctoral. One master program is in Mathematics (MATH) with 4 concentration areas, meanwhile the other one is in Statistics, called Master Program in Applied Statistics and Data Sciences (ASDS). Both master programs have an option for online completion. The doctoral program is not in traditional mathematics, but called PhD program in Mathematics and Statistics with Interdisciplinary Applications (MSIA) including four areas for students to complete the PhD dissertation: 1) Computational Math with Computer/Electrical Engineering, 2) Mathematical Biology and Nonlinear Mechanics, 3) Statistics with Data Analytics with Medical Applications, and 4) Mathematical Physics. I will talk about the details about the program admission and degree plan as well as GTA/GRA assistantships.

Faranak Rabiei (faranak.rabiei@tamuk.edu)
Texas A&M University Kingsville
Title: "Fractal-fractional-order modified Predator-Prey mathematical model with immigrations"
Abstract: This research aims to study a modified predator-prey models existence, stability, and dynamics under the newly developed fractal-fractional order operator in the Caputo-Fabrizio sense. The existence theory of the proposed model carries out through the Leray-Schauder alternative and sufficient conditions for stability are established using the classical technique of nonlinear functional analysis. The numerical results are obtained by the fractal-fractional Adam-Bashforth method in the Caputo-Fabrizio sense. The numerical results show that small immigrations invoke stable convergence in the predator-prey ecosystem. This means that a small number of sporadic immigrants can stabilize natural predator-prey populations.
Joint work with:
Zeeshan Ali, zeeshan.ali@monash.edu, Monash University, Malaysia
Kamyar Hosseini, kamyar_hosseini@yahoo.com, Near East University TRNC, Turkey

Vesselin Vatchev (vesselin.vatchev@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "On Solving Nonlinear PDEs in a Class of Rational Exponential Functions"
Abstract: There are no standard techniques to solve general nonlinear PDEs. Some of the classical approaches for certain types PDEs are to look for special type solutions (raveling waves), or special features of the PDE (symmetries), or linearize the equation (Lax pairs). In the talk we discuss particular solutions of nonlinear PDEs related to the Euler Equations in one spatial variable. These solutions can be related to the Hirota or tangent hyperbolic methods. We also introduce a large class of rational exponential functions (REF) in one spatial variable and discuss their properties. A method for finding solutions of certain PDEs with a polynomial type of nonlinearity is proposed in the class REF.
Joint work with:

Julio Paez

B. A. Zambrano-Luna (brian.zambrano@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Non-archimedean Reaction-diffusion Cellular Neural Networks"
Abstract: We present a non-archimedean reaction-diffusion cellular neural network. This network uses a non-archimedean analog of the Laplacian, the Vladimirov operator. We use this network to reduce the additive Gaussian noise for gray images. We also study the Cauchy problem attached to this network and present some examples.
Joint work with:
W.A. Zuniga-Galindo, wilson.zunigagalindo@utrgv.edu, The University of Texas Rio Grande Valley

W. A. Zuniga-Galindo (wilson.zunigagalindo@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "p-Adic Statistical Field Theory and Convolutional Deep Boltzmann Machines"
Abstract: Understanding how deep learning architectures work is a central scientific problem. Recently, a correspondence between neural networks (NNs) and Euclidean quantum field theories (QFTs) has been proposed. This work investigates this correspondence in the framework of p-adic statistical field theories (SFTs) and neural networks (NNs). In this case, the fields are real-valued functions defined on an infinite regular rooted tree with valence p, a fixed prime number. This infinite tree provides the topology for a continuous deep Boltzmann machine (DBM), which is identified with a statistical field theory (SFT) on this infinite tree. In the p-adic framework, there is a natural method to discretize SFTs. Each discrete SFT corresponds to a Boltzmann machine (BM) with a tree-like topology. This method allows us to recover the standard DBMs and gives new convolutional DBMs. The new networks use $O(N)$ parameters while the classical ones use $O(N^2)$ parameters.

Lihua Zuo (lihua.zuo@tamuk.edu)
Texas A&M University-Kingsville
Title: "Finite Difference Method for Three-Dimensional Fracture Propagation in Reservoir with Multi-Bedlayers"
Abstract: Weak horizontal interfaces between layers are observed in the field outcrops and core samples in unconventional reservoirs. Due to the opening of these interfaces, complex fracture geometry with vertical and horizontal segments are often generated. The existence of weak interfaces impedes fracture height growth and act as another mechanism for height containment, except the stress and rock property contrast. Due to a large amount of fluid leaking into the interfaces, the overall fracture geometry is affected based on material balance. In order to investigate the effects of opening of weak interfaces, we have developed a fully three-dimensional fracture propagation model to simulate fracture propagation in laminated reservoirs. Weak interfaces can arrest hydraulic fracture propagation and can be opened by injected fluid. In the model, fracture propagation path is predetermined. Vertical fracture segments are initially generated and propagate in different layers. Horizontal fracture segments are created in weak interfaces. Vertical fracture segments are connected by horizontal segments through right angles. The model simulates two-dimensional fluid flow within both vertical and horizontal fracture segments. We investigate the effects of opening of weak interfaces on fracture geometry, including fracture height, length, and width. Weak interfaces arrest fracture height growth and restrict fracture height. This model is validated with the analytical PKN model and obtained very close match. Then the fracture length is investigated with and without considering opening of interfaces. The results of the study provide critical guidelines for landing depth of horizontal wellbores and optimizing hydraulic fracturing treatments in unconventional reservoirs.
Joint work with:
Lihua Zuo, Texas A&M University-Kingsville
Kan Wu, Texas A&M University

2. Faculty Statistics talks

Mai Dao (mai.dao@wichita.edu)
Wichita State University

Title: "Bayesian binary quantile regression variable selection"
Abstract: In this talk, we discuss a Bayesian hierarchical model and associated computation strategy for simultaneously conducting parameter estimation and variable selection in binary quantile regression. We specify customary asymmetric Laplace distribution on the error term and assign quantile-dependent priors on the regression coefficients and a binary vector to identify model configuration. Thanks to the normal-exponential mixture representation of the asymmetric Laplace distribution, we proceed to develop a novel three-stage computational scheme starting with an expectation-maximization algorithm and then the Gibbs sampler followed by an importance re-weighting step to draw nearly independent Markov chain Monte Carlo samples from the full posterior distributions of the unknown parameters. Simulation studies are conducted to compare the performance of the proposed Bayesian method with that of several existing ones in literature. Finally, two real-data applications are provided for illustrative purposes.
Joint work with:
Min Wang (min.wang3@utsa.edu, The University of Texas at San Antonio)
Souparno Ghosh (sghosh5@unl.edu, University of Nebraska-Lincoln)

Eleftherios Gkioulekas (eleftherios.gkioulekas@utrgv.edu)
University of Texas Rio Grande Valley
Title: "Statistical evidence from case series data in support of early outpatient COVID-19 treatment protocols"
Abstract: When confronted with a public health emergency, significant innovative treatment protocols can sometimes be discovered by medical doctors at the front lines based on repurposed medications. We propose a statistical framework for analyzing the case series of patients treated with such new protocols, that enables a comparison with our prior knowledge of expected outcomes, in the absence of treatment. The goal of the proposed methodology is not to provide a precise measurement of treatment efficacy, but to establish the existence of treatment efficacy, in order to facilitate the binary decision of whether the treatment protocol should be adopted on an emergency basis. The methodology consists of a frequentist component that compares a treatment group against the probability of an adverse outcome in the absence of treatment, and calculates an efficacy threshold that has to be exceeded by this probability, in order to control the corresponding p-value and reject the null hypothesis. The efficacy threshold is further adjusted with a Bayesian technique, in order to also control the false positive rate. A random selection bias threshold is then calculated from the efficacy threshold to control for random selection bias. Exceeding the efficacy threshold establishes the existence of treatment efficacy by the preponderance of evidence, and exceeding the more demanding random selection bias threshold establishes the existence of treatment efficacy by the clear and convincing evidentiary standard. The combined techniques are applied to case series of high-risk COVID-19 outpatients that were treated using the early Zelenko protocol and the more enhanced McCullough protocol.
Joint work with:
Peter A. McCullough, peteramccullough@gmail.com, Truth for Health Foundation
Vladimir Zelenko, Former Affiliate Physician, Columbia University Irving Medical Center

Kun Gou (kgou@tamusa.edu)
Texas A&M University-San Antonio
Title: "Mechanical Characterization and Statistical Analysis for the Stiffness Parameters of Umbilical Arteries"
Abstract: The decellularized human umbilical arteries (UAs) after baby deliveries as by-pass grafts can be employed to repair the occluded or narrowed coronary arteries to restore the normal blood flow. To make the decellularization process more efficient, the outer thin lining layer of the UA is removed. The stiffness and compliance of the layer-reduced UA is different from the original UA. This study aims at establishing proper mathematical and statistical models and employing numerical techniques to obtain the stiffness parameters of the UA before and after the outer-layer removal. The differences between the corresponding experimental data and theoretical results are used to set up the objective function for parameter fitting via minimization. The mean values, sample standard deviations, and the R-squared values for measuring goodness of fitting are analyzed for the fitting effect. To study whether the layer-reduced UA significantly changes the stiffness, inferences for the relation of the parameter values from both the original and layer-reduced UAs are performed using the Student Distribution and P-value method.

The results are then analyzed for the lining-removed UAs adaptation to the host artery in the by-pass graft.
Joint work with:
Jin-Jia Hu, National Yang Ming Chiao Tung University, Taiwan.
Seungik Baek, Michigan State University

Zhuanzhuan Ma (zhuanzhuan.ma@utrgv.edu)
University of Texas Rio Grande Valley
Title: "Sparse Bayesian variable selection in high dimensional logistic regression models with correlated priors"
Abstract: We propose a sparse Bayesian procedure for the problems of variable selection and classification in high dimensional logistic regression models based on the global-local (GL) shrinkage prior framework. Particularly we first consider two types of GL shrinkage priors, the horseshoe (HS) prior and the normal-gamma (NG) prior, for the regression coefficients and then specify a correlated prior for the binary vector to distinguish models with the same size. By using mixture representations of the logistic distribution and the considered GL shrinkage priors, we construct a Bayesian hierarchical modeling, which allows researchers to develop an effective Markov chain Monte Carlo (MCMC)-based computation algorithm to generate posterior samples for making the posterior inference. We carry out simulations to compare the finite sample performances of the proposed Bayesian method with existing Bayesian methods in terms of the accuracy of variable selection and prediction. Finally, a real-data application is provided for illustrative purposes.
Joint work with:
Dr. Min Wang, min.wang3@utsa.edu, The University of Texas at San Antonio

Sarjinder Singh (kuss2008@tamuk.edu)
Texas A&M University-Kingsville
Title: "Bias Interrupters Developed Estimators Network (BIDEN) with a Mixture of TRUMP Cuts and Jackknifing"
Abstract: Quenouille (1956) introduced the idea that Jackknifing can be used to reduce bias resulting from using the ratio estimator due to Cochran (1940). Singh and Sedory (2017a) proposed the Tuned Ratio Unbiased Mean Predictor (TRUMP) where they introduced the idea of TRUMP Cuts. In this paper, we introduce the Bias Interrupters Developed Estimators Network (BIDEN) which utilizes the help of TRUMP Cuts and Jackknifing. We show that proper use of what we call BIDEN Care Coefficients could reduce the bias when using the ratio estimator even more than that obtained when using Quenouilles method. It could also be made more efficient than the sample mean estimator with an appropriated choice of TRUMP Care Coefficient. These new findings are supported with exact numerical computations using a well known set of data available in Horvitz and Thompson (1952).
Joint work with:
Stephen A. Sedory, sedorystephen@gmail.com, Texas A&M University-Kingsville

3. Student Mathematics talks

Joseph Omar Alanis (joseph.alanis@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Generalized Dissection Operators of Modular Forms"
Abstract: In many cases, dissecting a q-series of a modular form results in interesting identities among its Fourier coefficients. In this talk we study some algebraic aspects of dissection operators on the ring of formal power series $\mathbb{Z}[[q]]$, and attempt to formalize a question surrounding a special dissection operator indexed by a prime number p.
Joint work with:
Andrew Alaniz, andrew.alaniz01@utrgv.edu, The University of Texas Rio Grande Valley

Joselyne Aniceto (Joselyne.aniceto@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Cranks and Polyhedral Geometry"
Abstract: In a Technique in Partitions, Hansraj Gupta notes a novel method for computing formulas for restricted

partition functions. We provide a generalization for his formula and use it to prove an infinite family of congruences for a certain partition function. Then, using polyhedral geometry, we find and combinatorially prove several multiplicity based statistics that witness infinitely many aforementioned partition congruences.
Joint work with:
Brandt Kronholm, brandt.kronholm@utrgv.edu, The University of Texas Rio Grande Valley

Mahanthesh Basavarajappa (mahanthesh.b@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Maximum Density Effects on Rayleigh Benard Convection Problem"
Abstract: In this talk, the classical Rayleigh Benard convection problem is presented for the case of water with maximum density effect for the temperature range 0-300C. The governing equations consists of the conservation of mass, the Navier-Stokes equation for momentum, and the conservation of energy. The linear stability analysis is performed using the normal mode approach and the non-linear stability analysis is performed using the Fourier spectral method. The generalized trimodal Lorenz system is derived, leading to the Ginzburg-Landau equation. The numerical simulation of the marginal stability curves is also presented.
Joint work with:
Dambaru Bhatta

Saul J. Cardenas (hongwei.wang@tamiu.edu)
Department of Mathematics and Physics, Texas A&M International University, Laredo, Texas
Title: "Parental Involvement In Education"
Abstract: Parent involvement in the school system is crucial to students success and attachment to education. This research focuses on investigating the different methods each parent can practice to involve themselves in their child's education. This includes strategies districts can integrate into their schools in order to provide parents with opportunities for involvement. In addition, the aim is to compare and contrast the impacts children have when there is parental involvement and a lack of it. Of course, not every family has the advantages and/or live under the same conditions as other families. Many low social-economic families have fewer resources and experience in the education field. Many parents have skipped high school in order to provide for their families at a very young age. Overall, there are different strategies and routines that we must integrate and facilitate in each problem. These strategies can include full-service schools, implementing programs, and providing school materials to families. Parental involvement is very important because it has a great effect on the student. The goal is to understand the approaches that parents can adopt so their children can have a successful educational journey.
Joint work with:
Dr. Hongwei Wang

Exiquio Garcia (harag@tamiu.edu)
Department of Mathematics and Physics, Texas A&M International University, Laredo, Texas
Title: "Primes and Composites: From Old to New"
Abstract: The study of prime and composite numbers in the sequence of integer parts of powers of a fixed real number is the core of current number theory research. We first discuss why the study of this topic is much of our interest. Some prevailing elementary results are provided in the presentation to justify the goal. Finally, we provide some examples of prime conjectures and open questions associated with the theme. In particular, theories and techniques that lead to the determination of primes.
Joint work with:
Rohitha Goonatilake

Iris Lizette Gomez (irisg898@gmail.com)
Texas A&M University-San Antonio alumni
Title: "The Dynamics of Marriage Relationships with Mathematical Models"
Abstract: We may never think the marriage interaction can be mathematically modeled. It is indeed possible applying only fundamental college math. By the Rapid Couples Interaction Scoring System, a videotaped interactive discussion between the couple and detailed aspects of their emotions are coded to give scores for each one of the

couple. Humor and smiling are important for good relations generating positive scores, while anger or criticism is bad for relations generating negative scores. These scores are employed to construct score curves for both the husband and wife reacting to each other. We establish discrete mathematical models for these score curves, and use dynamics to study under what conditions the couple has stable or unstable marriage. Then our model is used to analyze how several personalities (including volatile, validating, and conflict-avoiding) of each one of the couple impact the stability of marriage.

Jena Gregory (jena.gregory01@utrgv.edu)
University of Texas Rio Grande Valley
Title: "Iterated Rascal Triangles"
Abstract: The Rascal Triangle is a result of inquiry based learning when middle school students were asked to complete rows of Pascals Triangle, but constructed the Rascal Triangle instead. We show the Rascal Triangle is one member of an infinite family of number triangles we call Iterated Rascal Triangles. These Iterated Rascal Triangles are unified by a single recursive formula and we will show how they are connected directly to Pascals triangle. Further student based learning produced additional identities in the Rascal Triangle and the discovery of Generalized Rascal Triangles. The Rascal Triangle is a basis for continued undergraduate projects or research with the prospect of added identities and connections to Pascals Triangle.
Joint work with:
Brandt Kronholm, brandt.kronholm@utrgv.edu, University of Texas Rio Grande Valley
Jacob A. White, jacob.white@utrgv.edu, University of Texas Rio Grande Valley

Julian V. Miranda (harag@tamiu.edu)
Department of Mathematics and Physics, Texas A&M International University, Laredo, Texas
Title: "Novel efficient algorithms for stochastic magnetohydrodynamic flow"
Abstract: We propose, analyze, and test a penalty-projection-based efficient splitting algorithm for computing magnetohydrodynamic (MHD) flow ensemble subject to the noise in the initial conditions, boundary conditions, forcing functions, and viscosity parameters. The stable decoupled algorithm uses Elsasser variable formulation and has two steps to compute the two identical Oseen-type sub-problems simultaneously at each time-step. It also permits a shared coefficient matrix for each of the realizations at each time-step but with different right-hand-side vectors, which allows taking advantage of block linear solvers. The stability of the theorem is proven rigorously. Several numerical experiments are given to compute the convergence rates using manufactured solutions.
Joint work with:
Muhammad Mohebujjaman, Ph.D.

Carlos Montes (carlos.montes02@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Understanding homeless population changes through interpretable, Shallow Neural Networks."
Abstract: Homelessness in America has become a major social issue over the last century and its impact on the livelihood of those affected is very dire. In this presentation we concern ourselves with the homeless population in the city of Los Angeles. We gather data, such as median rent and rate of crime, from the US census bureau and other sources and attempt to predict the degree of change in the homeless population on a census tract level over the course of 1 year. Our predictions rely upon Shallow Neural Networks (SNNs) whose features are determined by Random Forest Importance feature ranking. Due to the structure of an SNN we can also associate particularly large values of a specific feature with specific changes in the Homeless population. Notably, significantly above average homeless population in one year are associated with decreasing home population going into the next year; also, significantly above rates of crime are associated with increases in homeless population. Our findings help to provide a better understanding of homelessness in America along with possible correlation or causations.

Julio Paez (julio.paez01@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Approximate Solutions to the Two-Dimensional Euler Equations"
Abstract: In this talk, we find approximate solutions to the two-dimensional Euler equations for water in a shallow

channel using a special class of Rational Exponential Functions. This choice of functions yields solitary waves for the surface of the water.

Carolina Anahi Rizzi (hongwei.wang@tamiu.edu)
Department of Mathematics and Physics, Texas A&M International University, Laredo, Texas
Title: "Counting Lattice Points"
Abstract: In the recent century, various methods were developed to count the lattice points inside of a convex polytope due to their applications in pure and applied mathematics. In this talk, we discuss the use of Pick's Theorem and Ehrhart polynomials to determine the number of integer lattice points within polytopes. We examine how Pick's Theorem finds the area and number of lattice points within and on the boundary of a polygon and its subsequent relation to Erhart polynomials. Additionally, we will analyze the use of Ehrhart polynomials to count the lattice points in dilated two and three dimensional integral convex polytopes.
Joint work with:
Dr. Hongwei Wang

Maria F. Espericueta Sandoval (hongwei.wang@tamiu.edu)
Department of Mathematics and Physics, Texas A&M International University, Laredo, Texas
Title: "A Glimpse of Algebraic Numbers"
Abstract: The study of Algebraic Numbers relies on the discovery of roots of the subject that goes back to ancient Greece while its branches touch almost all aspects of contemporary Mathematics. In 1801, Carl Friedrich Gauss first published, a "Founding Treatise," for the modern attitude towards number theory. Many of the still unachieved aims of current research can be seen, at least in emergent form, as arising from Gausss historical work. This presentation is meant to serve as a prelude to the onlookers who might be interested in learning, and thinking about, some of the classical theory of algebraic numbers. Beginning with the fact that the inverse of a nonzero algebraic number is again an algebraic number, the sum, difference, and the product of two algebraic numbers are algebraic numbers, this expedition will carry forward in their backpacks Gausss as well as Davenports The Higher Arithmetic (1992) which is one of the aspects of exposition of the subject, and which explains the founding ideas clearly and in depth using hardly anything more than high-school mathematics. The study of algebraic numbers and algebraic integers begins with, and constantly reverts to, the study of ordinary rational numbers and ordinary integers. The first algebraic irrationalities appeared not so much as numbers but rather as obstructions to simple answers to questions found in geometry.
Joint work with:
Hongwei Wang

Changyan Shi (changyan.shi01@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Bright soliton solutions to a coupled Sasa-Satsuma equation"
Abstract: In this talk, we are concerned with bright soliton solutions to a coupled Sasa-Satsuma equation, the so-called CSSII equation. We first derive a set of bilinear equations by dependent variable transformations under the zero-boundary condition. Then, we construct the multi-bright soliton solutions to the CSSII equation through a series of reduction procedures such as CKP-, dimension- and complex conjugate reductions. The dynamical properties of one- and two-solitons are analyzed. Even the one-soliton has richer dynamical which can be classified into one-hump, two-hump and oscillated types. The interaction of two solitons is usually elastic and can lead to the change of the types after the collision.
Joint work with:
Baofeng Feng

Joel Williams (joel.williams01@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "An Algebraic Approach to 3-Dissection Operators on Spaces of Modular Forms"
Abstract: In this talk we study some algebraic aspects of collections of linear operators between finite dimensional complex vector spaces of modular forms. In particular, we'll address a series of conjectures posed by Huber,

Alaniz, and others predicting the form of the determinants of classes of integer-valued matrices associated with the aforementioned linear operators.

Joint work with:
Andrew Alaniz, andrew.alaniz01@utrgv.edu, The University of Texas Rio Grande Valley

4. Student Statistics talks

Theophilus Baidoo (gyedutheophilus10@gmail.com)
The University of Texas Rio Grande Valley

Title: "Survival modeling of Breast Cancer Patients with Random Survival Forests and Cox Proportional deep neural network (DeepSurv)"

Abstract: Breast cancer is the second most prevalent form of cancer in women in the United States. Each year, about 264,000 cases of breast cancer are diagnosed in women and of this number, about 42,000 women lose their lives each year as reported by the Center for Disease Control and Prevention (CDC). Early detection and effective treatment are crucial for improving survival rates and reducing mortality. The study aimed to explore the influential medical factors that may risk the survival of women with the disease. The study uses a dataset from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program containing information on 4024 women with infiltrating duct and lobular carcinoma breast cancer diagnosed between 2006 - 2010. We adopt the ensemble technique, Random Survival Forest (RSF) which was built as a time-to-event extension of the random forest that can handle high-dimensional data and interactions between variables, and the Cox Proportional deep neural network (DeepSurv) that can handle complex nonlinear relationships between covariates. The Random survival forest model was proposed based on the log-rank and log-rank score split criteria. To improve the interpretability of the results and to reduce noise, the RSF feature selection was used to determine these influential factors using the variables obtained from the Cox regression hazard model as a benchmark. More notably, the Shapley Additive explanation (SHAP) was utilized in the study to shed some light on the models' performance and to facilitate the interpretation of the model's variables.

Purna chandra sekhar rao Bellamkonda (purna6581@gmail.com)
Texas A&M University- Kingsville

Title: "Introduction to SAS programming: Be a Birth Weekday Winner!"

Abstract: In this talk, we will present a few basic SAS procedures for producing descriptive statistics. The output from various SAS procedures can be combined to develop a program to analyze a data set or to perform a simulation study. The process of generating random numbers from various distributions with and without a seed value will be discussed. Any attendee who wish to know the birthday of the week from the date of birth using SAS must attend this talk. The winning weekday will be decided based on a random selection out of seven weekdays.

Joint work with:
Sarjinder Singh, kuss2008@tamuk.edu, Texas A&M University-Kingsville

Dipok Deb (dipok.deb01@utrgv.edu)
The University of Texas Rio Grande Valley

Title: "Optimal quantization for discrete distributions"

Abstract: In this study, the optimal sets of n-means and the nth quantization errors has been determined for all $1 \leq n \leq 6$ for two nonuniform discrete distributions with support the set $\{1, 2, 3, 4, 5, 6\}$. Then, for a probability distribution P with support the set N of natural number associated with a mass function f, given by $f(x) = 1/2^k$ if $x = k$ for $k \in \mathbb{N}$, and zero otherwise, we determine the optimal sets of n-means and the n^{th} quantization errors for all positive integers n. Further, for a probability distribution P with support $\{1/n \mid n \in \mathbb{N}\}$ associated with a mass function f, given by $f(x) = 1/2^k$ if $x = 1/k$ for $k \in \mathbb{N}$, and zero otherwise, we determine the optimal sets of n-means and the n^{th} quantization errors for all positive integers up to $n = 300$.

Joint work with:
Dr. Mrinal Kanti Roychowdhury, The University of Texas Rio Grande Valley

Srikar Govardhana (srikar.govardhana@students.tamuk.edu)
Texas A&M University - Kingsville
Title: "On the estimation of empirical mode"
Abstract: In this talk, we will discuss the problem of estimation of empirical mode by following Doodson (1917). A new estimator of the empirical mode in presence of known Bowley's coefficient of skewness will be introduced. The bias and variance expressions for the proposed estimator are derived for simple random without replacement sampling scheme. Simulation study has been performed to compare the proposed estimator with the Doodson's estimator for various situations, and findings will be discussed.
Joint work with:
Sarjinder Singh, kuss2008@tamuk.edu, Texas A&M University - Kingsville

Saikou Jawla (saikoujawla95@gmail.com)
University of Texas Rio Grande Valley
Title: "Data Science of Hospital Antibiotic Stewardship"
Abstract: Antibiotics are widely used to treat bacterial infections, but their misuse have led to antibiotic resistance. Antibiotic resistance is one of the biggest threats to global health, food security, and development today. Antibiotic resistance leads to higher medical costs, prolonged hospital stays, and increased mortality. Antimicrobial stewardship is an approach to measure and improve the appropriate use of antibiotics in healthcare settings. Data science has the potential to support these programs by providing insights into antibiotic prescribing patterns, identifying areas for improvement, and predicting patient outcomes. We explored the role of data science in hospital antibiotic stewardship programs, including statistical methods and data visualization techniques. We conducted statistical analysis to identify trends and seasonality in antibiotic usage using autoregressive integrated moving average (ARIMA) models and generalized additive model (GAMs). We developed a pilot interactive dashboard for hospital inpatient antibiotic stewardship using Python. The dashboard allows for visualizing trends in the antibiotic stewardship metric days of therapy (DOT) by various categories, such as indication, therapeutic class, and time. The use of digital dashboards in healthcare is becoming increasingly popular and our work demonstrates the potential of data visualization tools in supporting hospital antibiotic stewardship.
Joint work with:
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Nicholas Niako (nicholas.niako01@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "Effect of missing data imputation methods on univariate time series forecasting with ARIMA and LSTM"
Abstract: In this work we evaluated the predictive performance of autoregressive integrated moving average (ARIMA) and long short-term memory (LSTM) recurrent neural network model on imputed time-series data using Kalman with ARIMA filtering, Kalman filtering with structural time series, exponentially weighted moving average, simple moving average, mean imputation, linear interpolation, Stine interpolation, and KNN imputation techniques under missing completely at random (MCAR) mechanism. Missing values were generated artificially at 10%, 15%, 25%, and 35% rate using complete data of 48-hours ambulatory blood pressure readings. The performance of ARIMA and LSTM models were compared on imputed and original data as the baseline using mean absolute percentage error (MAPE) and root mean square error (RMSE). Based on the results, mean imputation was the best technique, resulting with the smallest MAPE and RMSE at 10% rate of missingnes. At 15% rate of missingness, the exponentially weighted moving average outperformed the other techniques in terms of RMSE and Stine interpolation was the best method of imputation based on MAPE. At 25% rate of missingness, Kalman filtering with structural time series performed better than the other techniques based on both RMSE and MAPE. Kalmnan filtering with structural time series was the best in terms of RMSE, and Kalman filtering with ARIMA filtering was the best technique in based on MAPE at 35% of missingness.
Joint work with:
Dr. Kristina Vatcheva (kristina.vatcheva@utrgv.edu), The University of Texas Rio Grande Valley

Gladys Maestre (gladys.maestre@utrgv.edu), The University of Texas Rio Grande Valley
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Evans Nyanney (evans.nyanney01@utrgv.edu)
University of Texas Rio Grande Valley
Title: "Quantization for the mixtures of overlap probability distribution"
Abstract: Mixtures of probability distributions, also known as mixed distributions, are an exciting new area for optimal quantization. In this paper, we have considered a mixed distribution which is generated by overlap uniform distributions. For this mixed distribution we determine the optimal sets of n-means and the nth quantization errors for all positive integers n. We provide an algorithm based on a sequence of integers that can be used to determine the optimal sets of n-means. The algorithm involves computing a sequence $\{a(n)\}$ for each positive integer n, where $a(n)$ is the minimum number of intervals needed to cover the support of the mixed distribution with n-means. We show that this sequence satisfies certain recursive properties and can be computed efficiently. Using this sequence, we then determine the optimal sets of n-means and corresponding quantization errors for all positive integers $n \geq 5$. We show that for certain values of n, the optimal sets of n-means have a simple structure that can be easily described. Overall, the algorithm provides a systematic way to determine the optimal sets of n-means for mixtures of probability distributions generated by overlap uniform distributions.
Joint work with:
Dr. Mrinal Kanti Roychowdhury, The University of Texas Rio Grande Valley

Madison Riba (mriba@islander.tamucc.edu)
Texas A&M University-Corpus Christi
Title: "Statistical Modeling of Cruise Data in the Gulf of Mexico"
Abstract: The Gulf of Mexico (GoM) is known for its rich biodiversity and numerous coral habitats. This sensitive region is of high interest for environmental prediction as climate change impacts the area. Through NOAAs Ocean Acidification Program, the fourth Gulf of Mexico Ecosystems and Carbon Cruise (GOMECC-4) collected data throughout the gulf in the fall of 2021. In this project, spatial and temporal models will be used for studying GoM data, including those from GOMECC excursions, with some visualized results. Various variables and their relationships will be evaluated, including surface temperature, CO2 levels, and salinity. In performing a comprehensive analysis of the region, robust models will be introduced to researchers across disciplines.
Joint work with:
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Omar Sharif (sharifdu88@gmail.com)
Daffodil International University, Dhaka, Bangladesh
Title: "Analyzing the Impact of Demographic Variables on Spreading and Forecasting COVID-19"
Abstract: The aim of this study is to analyse the coronavirus disease 2019 (COVID-19) outbreak in Bangladesh. This study investigates the impact of demographic variables on the spread of COVID-19 as well as tries to forecast the COVID-19 infected numbers. First of all, this study uses Fishers Exact test to investigate the association between the infected groups of COVID-19 and demographical variables. Second, it exploits the ANOVA test to examine significant difference in the mean infected number of COVID-19 cases across the population density, literacy rate, and regions/divisions in Bangladesh. Third, this research predicts the number of infected cases in the epidemic peak region of Bangladesh for the year 2021. As a result, from the Fishers Exact test, we find a very strong significant association between the population density groups and infected groups of COVID-19. And, from the ANOVA test, we observe a significant difference in the mean infected number of COVID-19 cases across the five different population density groups. Besides, the prediction model shows that the cumulative number of infected cases would be raised to around 500,000 in the most densely region of Bangladesh, Dhaka division.
Joint work with:
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Tania Vargas (tania.vargas01@utrgv.edu)
The University of Texas Rio Grande Valley
Title: "A Machine Learning Approach to Obesity Phenotyping"
Abstract: Obesity is the accumulation of an abnormal or excessive amount of fat in the body, which can have negative effects on overall health. This excess accumulation of macronutrients in adipose tissue can cause the release of inflammatory mediators, leading to a pro-inflammatory state. Inflammation is a known risk factor for various health conditions, including cardiovascular diseases, metabolic syndrome, and diabetes. This study sought to examine the use of data mining methods, particularly clustering algorithms, to identify inflammatory biomarker phenotypes and their correlation with obesity in Mexican American adolescents from the Lower Rio Grande Valley. The clustering algorithms evaluated in this study included K-Means, Hierarchical Ward's method, Fuzzy C-Means, Gaussian Mixture Model, and Principal Component Analysis. The algorithms were assessed based on different validation indices and graphs of the resulting clusters. The results showed that K-Means, $k = 3$, produced the most accurate clustering results. Additionally, adolescents with a higher BMI and waist circumference had a greater likelihood of being grouped in Cluster 2, which was characterized by higher levels of lCRP and lLeptin. Although Principal Component Analysis is a different type of clustering algorithm, it also produced two components that grouped lCRP and lLeptin in the first principal component. These findings suggest that there is a positive correlation between lCRP and lLeptin and higher BMI and waist circumference in Mexican American adolescents from the Lower Rio Grande Valley.
Joint work with:
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