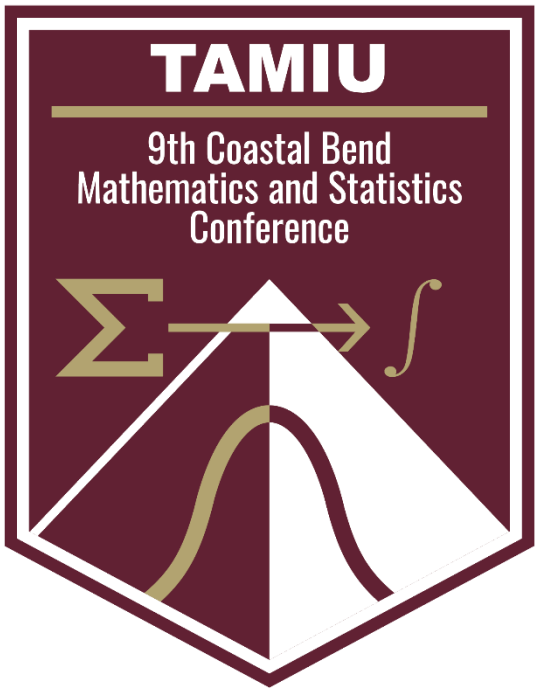
The 9th Coastal Bend Mathematics and Statistics Conference

PROGRAM



Texas A&M International University
Laredo, TX, 78041

April 5th, 2025

Contents

[1] Presentation abstracts are sorted in the alphabetical order of presenters' names. The presenters are identified by an asterisk (*).

Foreword

Welcome to Texas A&M International University and the 9th Coastal Bend Mathematics and Statistics Conference. It is my sincere pleasure to join our College of Arts and Sciences, Department of Mathematics and Physics in hosting you on our beautiful, 300-acre campus. With over 120 faculty, student, and poster presentations, this year's conference is among the largest in recent history.

It has been jokingly said there are *three* kinds of people in the world: those who can count and those who can't! As the CFO of our institution, in addition to interim president, I would not normally consider myself to be in the latter category, but as I perused the sessions offered here today, my daily math of *dollars and cents, debits and credits* seems like child's play. The research being conducted at the institutions of higher education attending this year's Conference is just extraordinary.

"There is no branch of mathematics, however abstract, which may not someday be applied to phenomena of the real world."

So said the Russian mathematician, Nikolai Lobachevsky, and I think we can all agree that mathematics, including the most theoretical concepts and those concepts that appear unrelated to real-world applications, may one day very well describe or predict physical phenomena.

In our lifetimes, we have witnessed incredible advances in science and technology resulting from once abstract mathematical concepts. What is being done here today, and the level of interest and research in mathematical exploration presented here, may one day lead to profound, unimaginable discoveries later, and I, for one, can hardly wait.

I hope you find your time here enlightening, inspiring, and enjoyable.

¡Bienvenidos a todos!

Juan J. Castillo
Interim President and CFO
Texas A&M International University

Foreword

Welcome to the 9th Annual Coastal Bend Mathematics and Statistics Conference at Texas A&M International University! It is with great pleasure and excitement that we gather here today to celebrate the collective advancement of mathematics and statistics within our academic community. Mathematics and statistics are the foundations of multiple disciplines. In today's technological age, mathematics has played a major role in various technological discoveries and improvements, making it a key foundation for the various engineering fields. This conference serves to highlight the importance of mathematics and statistics by providing a platform for collaboration, learning, and exchange among professionals, students, and enthusiasts in the fields of mathematics and statistics from across the region and beyond.

The Coastal Bend Mathematics and Statistics Conference (CBMSC) is an annual event that brings together researchers working in all areas of mathematics and related fields. The first CBMSC took place in Texas A&M University-Corpus Christi (TAMU-CC) back in 2016. This one-day conference was created to encourage students and faculty to present and share their research. The continuous success of this conference has attracted presenters from across the country.

This year's conference features an exceptional lineup of speakers, presentations, and sessions that highlight the diversity and richness of the mathematical sciences. Whether you are here to present your research, share ideas with colleagues, or expand your knowledge, we hope that you will leave inspired, energized, and connected with others who share your passion for these essential fields.

We would like to extend our heartfelt thanks to all the attendees, speakers, and sponsors who have made this event possible. Your continued support ensures that the Coastal Bend Mathematics and Statistics Conference remains a premier event for intellectual growth and professional development.

We would like to congratulate all participants and presenters for their contributions and advancements in their respective fields of study, which will enrich the future of mathematics and statistics. Once again, we look forward to an exceptional and enriching day, and we thank you for being part of this special occasion.

Dr. Claudia E. San Miguel
Provost and Vice President for Academic Affairs
Texas A&M International University

Foreword

Dear Participants and Organizers of the 9th Coastal Bend Mathematics and Statistics Conference,

It is with great pleasure and pride that I extend my warmest greetings to all of you on behalf of Texas A&M International University (TAMIU) and the College of Arts and Sciences. As the Interim Dean, I am honored to witness the convergence of brilliant minds and dedicated professionals at this esteemed conference. The Coastal Bend Mathematics and Statistics Conference has always been a beacon of knowledge, innovation, and collaboration. This year's gathering is no exception, as it brings together scholars and students from the South Texas region and beyond who are dedicated and passionate about advancing the fields of mathematics and statistics. Your participation and contributions are vital to the continued growth and development of these disciplines.

At TAMIU, our mission is to provide a learning environment that fosters intellectual growth, critical thinking, and the pursuit of knowledge. The College of Arts and Sciences is committed to nurturing a culture of academic excellence, research, and community engagement. We believe that education is the cornerstone of a thriving society, and we strive to empower our students to become leaders and innovators in their respective fields.

Our university is on an exciting journey towards its aspiration of attaining Research 2 (R2) university status, a designation that recognizes U.S. institutions with high research activity. This trek is a testament to our unwavering commitment to research, scholarship, and the creation of new knowledge. The collection of work being presented at this conference aligns perfectly with our mission and our aspirations. It is through events like these that we can show case the remarkable research being conducted by our faculty and students and highlight the impact of our collective efforts on the broader academic community. The theme of this year's conference, "Mathematics Curriculum Transformation in South Texas," resonates deeply with our goals at TAMIU. It underscores the importance of interdisciplinary collaboration and the application of mathematical and statistical knowledge methods to solve real-world problems. As we strive to reach new heights in research and innovation, we are inspired by the dedication and ingenuity of the participants and organizers of this conference.

I would like to extend my heartfelt gratitude to the organizing committee and faculty members of the TAMIU Department of Mathematics and Physics for their tireless efforts in organizing this event. Your dedication to fostering a vibrant academic community is truly commendable. To the participants, I encourage you to take full advantage of the opportunities presented at this conference. Engage in meaningful discussions, share your insights, and build lasting connections with your peers.

In closing, I wish you all a productive and inspiring conference. Let us continue to work together to advance the frontiers of knowledge and contribute to the betterment of our society. Thank you for your commitment to excellence and for being a part of this remarkable event.

Warm regards,

Marcus Antonius Ynalvez, Ph.D.
Interim Dean, College of Arts and Sciences
Texas A&M International University

Plenary Speaker

MATHEMATICS CURRICULUM TRANSFORMATION IN SOUTH TEXAS

Afi Y. Wiggins, Ph.D.

Managing Director, Charles A. Dana Center, The University of Texas at Austin

The presentation aims to inform mathematics educators, administrators, policymakers, and other stakeholders in the region about ongoing efforts to dismantle barriers in education and to create innovative mathematics and science education initiatives that support student success. Dr. Wiggins will also highlight various pathways to obtaining degrees in these fields, showcasing the numerous opportunities available in the region and the rewarding nature of STEM disciplines for our students and faculty.

Biography: Dr. Afi Y. Wiggins, a veteran in P20 education research and practice, serves as the managing director of the Charles A. Dana Center. With decades of experience, she leads the development and implementation of evidence-based strategies for systemic educational reform. Afi drives initiatives that empower learners to enhance their social and economic mobility, promoting nationwide improvements in numeracy and literacy. She sets and executes strategic priorities for both programmatic and philanthropic growth. As a transformational leader and lifelong educator, Afi fosters a culture of systemic change, prioritizing the use of impact evidence to guide decisions and ensure continuous advancements in education.

1 Meeting Information

1.1 Meeting Schedule

8:00–8:30 A.M.	Breakfast and Registration	(STC[1] Ballroom (2nd Floor))
8:30–9:00 A.M.	Welcoming Words	(STC Ballroom)
9:00–9:30 A.M.	Plenary Speaker	(STC Ballroom)
9:40–11:20 A.M.	Morning Sessions-I	(STC and PLG)
	Session MIF1 (Faculty - Statistics and Data Sciences)	(STC 230)
	Session MIF2 (Faculty - Applied Mathematics)	(STC 231)
	Session MIF3 (Faculty - Applied Mathematics)	(STC 120)
	Session MIF4 (Faculty - Math Education)	(PLG 114)
	Session MIS1 (Student - Applied Mathematics)	(PLG 115)
11:20–11:40 A.M.	Coffee Break	(STC Ballroom)
11:40 A.M.–1:20 P.M.	Morning Sessions-II	(STC and PLG)
	Session MIIF1 (Faculty - Statistics and Data Sciences)	(STC 230)
	Session MIIF2 (Faculty - Applied Mathematics)	(STC 231)
	Session MIIF3 (Faculty - Applied Mathematics)	(STC 120)
	Session MIIS1 (Student - Applied and Pure Mathematics)	(PLG 114)
	Session MIIS2 (Student - Statistics and Data Sciences)	(PLG 115)
	Session MIIP (Student - Poster Session)	(STC Ballroom)
1:30–2:30 P.M.	Lunch	(STC Ballroom)
2:40–4:40 P.M.	Afternoon Sessions-I	(STC and PLG)
	Session AIF1 (Faculty - Statistics and Data Sciences)	(STC 230)
	Session AIF2 (Faculty - Applied Mathematics)	(STC 231)
	Session AIF3 (Faculty - Math Education)	(STC 120)
	Session AIF4 (Faculty - Applied Mathematics)	(PLG 112)
	Session AIS1 (Student - Statistics and Data Sciences)	(PLG 114)
	Session AIS2 (Student - Math Education)	(PLG 115)

[1]For Building Codes, please refer to TAMIU Campus Map in page 49.

4:20–4:40 P.M.	Coffee Break	(STC Ballroom)
4:40–5:40 P.M.	Afternoon Sessions-II	(STC and PLG)
	Session AIIS1 (Student - Applied Mathematics)	(STC 230)
	Session AIIS2 (Student - Class Topics)	(STC 231)
	Session AIIS3 (Student - Class Topics)	(STC 120)
	Session AIIS4 (Student - Class Topics)	(PLG 114)
	Session AIIS5 (Student - Applied Mathematics)	(PLG 115)
6:00 P.M.	Conference Adjourn	(STC)

1.2 Parallel Session Schedule

Parallel Session Coordinators

Ms. Sofía C. Maldonado is the Coordinator of all morning parallel sessions (9:30 A.M.-1:30 P.M.).

Mr. Exiquio Garcia is the Coordinator of all afternoon parallel sessions (2:30-6:00 P.M.).

Parallel Session Coordinators are responsible for managing and overseeing the smooth execution of parallel sessions during the conference. They serve as the primary point of contact for speakers and participants, addressing any technical or logistical issues that may arise during their assigned sessions. This includes troubleshooting audiovisual equipment, coordinating with technical support teams, and helping speakers with any last-minute changes or concerns. Parallel Session Coordinators are found at the registration table in the STC Ballroom (2nd floor).

1.2.1 Morning Sessions-I - 9:40–11:20 A.M.

`Session MIF1 (Faculty - Statistics and Data Sciences)`

Moderator: Saqib Hussain .....(STC 230)

9:40-10:05 Daniel Arias* and Sarjinder Singh, *Texas A&M University-Kingsville*[2]
On randomized response techniques

10:05-10:30 Sreelekha Guggilam* and Ruhaan Singh, *Texas A&M University-Corpus Christi*
Anomaly detection based data distillation for image processing

10:30-10:55 Ahmed Al-Taweel, Saqib Hussain*, and S.M. Mallikarjunaiah, *Texas A&M International University*
Analyzing mob dynamics in social media networks using epidemiology model

10:55-11:20 Monique T. Cano, Aayush Mitra, Orrin D. Ware, Omar Sharif, and Michael R. Lindstrom*, *University of Texas Rio Grande Valley*
Data-driven study of mental health disorders: identifying patterns in substance use problems and mental health disorders

`Session MIF2 (Faculty - Applied Mathematics)`

Moderator: Kun Guo .....(STC 231)

9:40-10:05 Mahanthesh Basavarajappa, *Texas A&M International University*
Thermal stability analysis of kelvin-voigt fluids in porous media

10:05-10:30 Dambaru Bhatta, *University of Texas Rio Grande Valley*
Analysis of thermo-solutal convective flow in porous media

10:30-10:55 Alexandr Chernyavskiy*, Barbara Prinari, D.J. Frantzeskakis, T.P. Horikis, and G.N. Koutsokostas, *Texas A&M University-Corpus Christi*
Dark-bright soliton perturbation theory for the Manakov system

10:55-11:20 Kun Gou, *Texas A&M University-San Antonio*
Study of blood flow under one-dimensional hyperelastic calcified arteries

[2]In the rest of the Conference Program, only the presenter's institution is provided. The presenter of a multiple-author presentation is identified by an asterisk (*).

`Session MIF3 (Faculty - Applied Mathematics)`

Moderator: Runchang Lin .....(STC 120)

9:40-10:05 Aden Ahmed, *Texas A&M University-Kingsville*
Quantized rock-paper-scissors: a preliminary report

10:05-10:30 Leyzar Acosta, *Laredo College*
How engineers utilize center of mass in every structure

10:30-10:55 Zhuolin Qu* and Lauren M. Childs, *University of Texas at San Antonio*
Assessing the impact of the Wolbachia-based control of malaria

10:55-11:20 Maria Vasilyeva, *Texas A&M University-Corpus Christi*
Coarse grid approximation and two-grid preconditioner for problems in heterogeneous domain

`Session MIF4 (Faculty - Math Education)`

Moderator: Norma Saikali .....(PLG 114)

9:40-10:05 Juan Manuel Gonzalez, *St. Augustine High School*
Applications for χ-square and goodness-of-fit statistical tests using the TI-84 graphing calculator

10:05-10:30 Roger Knobel, *University of Texas Rio Grande Valley*
Engaging secondary teachers in doing mathematics

10:30-10:55 Karla Linero-Reyes* and Alma Jasso-Chavez, *Texas A&M International University*
Expanding corequisite mathematics success: leveraging the CRSM grants for institutional transformation

10:55-11:20 Luis C. Montemayor Garza, *Laredo ISD*
How to teach Algebra to students with learning disabilities

`Session MIS1 (Student - Applied Mathematics)`

Moderator: Cesar Contreras .....(PLG 115)

9:40-10:00 Myrine Barreiro-Arevalo*, Mike Lindstrom, and Eloi Camprubi-Casas, *University of Texas Rio Grande Valley*
Synthesis and characterization of vesicle compartments to study the origins of heredity

10:00-10:20 Subarna Biswas* and Devanayagam Palaniappan, *Texas A&M University-Corpus Christi*
Analytical solutions for two-dimensional oscillatory flows with velocity slip

10:20-10:40 Kamille Garcia, *Texas A&M International University*
Analytical solution of Stokes-II problem for Kelvin-Voigt fluid

10:40-11:00 Maria Pieo Fernando* and S. M. Mallikarjunaiah, *Texas A&M University-Corpus Christi*
On a finite element approach for a spatially adaptive phase-field model for quasi-static crack propagation

11:00-11:20 Joshua Lopez, *University of Texas at San Antonio*
Assessing the impact of seasonality on Wolbachia-based controls for mosquito-borne diseases

1.2.2 Morning Sessions-II - 11:40 A.M.–1:20 P.M.

`Session MIIF1 (Faculty - Statistics and Data Sciences)`
Moderator: Saqib Hussain .....(STC 230)

11:40-12:05 Roberto R. Heredia* and Richard D. Hartley, *Texas A&M International University*
The statistical truth in social behavioral statistics

12:05-12:30 Yifan Hsu, *Texas A&M University-Kingsville*
Integrating AI into imbalanced data learning

12:30-12:55 Zhuanzhuan Ma, *University of Texas Rio Grande Valley*
Bayesian nonparametric hypothesis testing methods on multiple comparisons

12:55-1:20 Rolando Pena-Sanchez, *Texas A&M International University*
Nonparametric statistical comparison of unemployment in the US, Mexico and Canada

`Session MIIF2 (Faculty - Applied Mathematics)`
Moderator: Mahanthesh Basavarajappa .....(STC 231)

11:40-12:05 Dambaru Bhatta, *University of Texas Rio Grande Valley*
Mucus transport due to ciliary movement in trachea

12:05-12:30 Gangadhara Boregowda* and Michael R. Lindstrom*, *University of Texas Rio Grande Valley*
Existence theory: a neuron-centered spatiotemporal model of the unfolded protein response in prion diseases

12:30-12:55 Juan B. Gutiérrez, *University of Texas at San Antonio*
Monomial activation functions for artificial neural networks

`Session MIIF3 (Faculty - Applied Mathematics)`
Moderator: Runchang Lin .....(STC 120)

11:40-12:05 Wen-Ming He, Runchang Lin*, Tian Tian, Huayi Wei, and Zhimin Zhang, *Texas A&M International University*
Richardson extrapolation for C^0 interior penalty finite element method for biharmonic problems

12:05-12:30 Ram Manohar* and S.M. Mallikarjunaiah, *Texas A&M University-Corpus Christi*
Discontinuous Galerkin methods for quasi-static boundary value problems: Newton linearization and error analysis

12:30-12:55 Jose Morales, *University of Texas at San Antonio*
Computational methods for quantum and semiclassical kinetic equations

12:55-1:20 Erwin Suazo* and Jose Escorcia, *University of Texas Rio Grande Valley*
Explicit solutions for nonlinear PDEs systems with variable coefficients

`Session MIIS1 (Student - Applied and Pure Mathematics)`
Moderator: Norma Saikali .....(PLG 114)

11:40-12:00 Saugata Ghosh*, Dambaru D Bhatta, and S. M. Mallikarjunaiah, *University of Texas Rio Grande Valley*
On a computational model to analyze crack-tip fields in a transversely isotropic body

12:00-12:20 Jesus A. Mendiola Herrera, *Texas A&M International University*
A preliminary study of Hilbert-Kunz functions: coefficient behavior in a normal affine semigroup ring

12:20-12:40 Ananya Gopal Hegde* and S. M. Mallikarjunaiah, *Texas A&M University-Corpus Christi*
An iterative numerical approach for nonlinear wave propagation in elastic bars

12:40-1:00 Omar Sharif*, Blossomhill Chao, Daniel Gutierrez III, Allegra Simmons, Michael R. Lindstrom*, Tamer Oraby, and Gangadhara Boregowda*, *University of Texas Rio Grande Valley*
Deterministic and stochastic models of prion protein misfolding: implications for disease progression and intervention strategies

1:00-1:20 Joel Williams* and Mike Lindstrom, *University of Texas Rio Grande Valley*
Mathematical modeling of neurodegenerative prion diseases in one-dimensional neuronal networks

`Session MIIS2 (Student - Statistics and Data Sciences)`
Moderator: Cesar Contreras .....(PLG 115)

11:40-12:00 Selina Carter* and Arun Kumar Kuchibhotla, *Carnegie Mellon University*
Inference for Online Algorithms without Variance Estimation

12:00-12:20 Jose Herrera, *Texas A&M International University*
Different Treatment Drugs for Patients with Type 2 Diabetes

12:20-12:40 Yejin Hwang, *Texas A&M University-Corpus Christi*
Stock Market Price Prediction using ARIMA, Temporal Fusion Transformer, and DeepAR

12:40-1:00 Hermes Luna*, Deepak Ganta, Marcus Antonius Ynalvez, and Maria Lopez, *Texas A&M International University*
Statistical Data Analytics and Assessment of Engineering Psychosocial Outcomes

1:00-1:20 Ashley Marines, *Texas A&M University-Corpus Christi*
Bridging Attention and Convolution: A Knowledge Distillation Framework for Object Detection

`Session MIIP (Student - Poster Session)`
Moderator: Juan J. Arellano Jr. .....(STC Ballroom)

11:40-1:20 Roberto Arias*, Kristina Vatcheva, Vesselin Vatchev, Jesus Melgarejo, and Gladys Maestre, *University of Texas Rio Grande Valley*
Novel feature extraction from ambulatory blood pressure data

11:40-1:20 Jorge Alejandro Cuevas, *Laredo College*
Financial literacy - budgeting with math

11:40-1:20 Donaldo Davila, Max Lopez, and Juan Bernal*, *Laredo College*
The center of mass: a key to stable structures in engineering

11:40-1:20 Andres Cabello* and Gerardo Guerrero*, *Laredo College*
Battery discharge rate across common brands

11:40-1:20 Zhuolin Qu and Lauren Estrada*, *University of Texas at San Antonio*
Modeling the interplay of human behaviors and mosquito-borne diseases through behavior-driven socio-biological framework

11:40-1:20 Isaac Garay, *Texas A&M International University*
Fourier transformations and its relationship to MRI

11:40-1:20 Osvaldo Garza, *Laredo College*
Error detection and correction in cybersecurity

11:40-1:20 Edward Gomez Jr., *Laredo College*
The Differences in the way drones are operated based on size

11:40-1:20 Jeffery Opoku, *University of Texas Rio Grande Valley*
Ramanujan-fine integrals for level 10

11:40-1:20 Ben-Oni Spradlin, *University of Texas Rio Grande Valley*
A mathematical model of Alzheimer's diseases

11:40-1:20 Samiha Zakir* and Kristina Vatcheva, *University of Texas Rio Grande Valley*
Joint modelling of longitudinal estimated glomerular filtration rate and time to acute kidney injury

1.2.3 Afternoon Sessions-I - 2:40 P.M.–4:20 P.M.

`Session AIF1 (Faculty - Statistics and Data Sciences)`
Moderator: Saqib Hussain .....(STC 230)

2:40-3:05 Min Wang, *University of Texas at San Antonio*
Double-robust Bayesian variable selection and model prediction with spherically symmetric errors

3:05-3:30 Rolando Pena-Sanchez, *Texas A&M International University*
Statistical curvilinear regression of CO_2 per GDP in the US, China, Japan, Germany and India

3:30-3:55 Orlando M. Patricio*, Hongwei Wang, Fernando G. Quintana, Rohitha Goonatilake, Amelia Solis, and Raonaq I. Mia, *Laredo College*
Epidemiological models of murine typhus in South Texas

3:55-4:20 Madison De Los Santos, *Texas A&M International University*
Utilizing machine learning techniques to predict credit card payment defaults

`Session AIF2 (Faculty - Applied Mathematics)`
Moderator: Hongwei Wang .....(STC 231)

2:40-3:05 Chris Trombley* and Sul Song, *Texas A&M University-Kingsville*
Existence and regularity for compressible and barotropic unsteady stokes flows

3:05-3:30 Tong Wu*, Humberto Godinez, Vitaliy Gyrya, and James M. Hyman, *The University of Texas at San Antonio*
Interpolated discrepancy data assimilation for PDEs with sparse observations

3:30-3:55 Lihua Zuo, *Texas A&M University-Corpus Christi*
Pressure and rate analysis for shale gas reservoirs using anomalous diffusions

3:55-4:20 Hongwei Wang, *Texas A&M International University*
A three-dimensional approach to nutrition: mapping daily meals using XYZ coordinates

`Session AIF3 (Faculty - Math Education)`
Moderator: Mahanthesh Basavarajappa .....(STC 120)
2:40-3:05 Hongwei Wang, Cody J. Perry*, and Saul Cardenas, *Texas A&M International University*
How does education impact a family's overall well-being and quality of life
3:05-3:30 Juan Manuel Gonzalez, *St. Augustine High School*
Using Zeller's congruence and the greatest integer function to calculate the day of the week for any date in history when using the Gregorian Calendar
3:30-3:55 Jamila Moneda*, Ximena Benavides Puerto, Marcus Antonius Ynalvez, Claudia San Miguel, Ruby Ynalvez, Deepak Ganta, Runchang Lin, Marcela Moran, and Leonela Preciado, *Texas A&M International University*
Exploring psychosocial outcomes in first-year undergraduate STEM students: the impact of a set of creative video projects (CVP) intervention on STEM-Efficacy and STEM-Identity

`Session AIF4 (Faculty - Applied Mathematics)`
Moderator: Juan J. Arellano Jr. .....(PLG 112)
2:40-3:05 S. M. Mallikarjunaiah, *Texas A&M University-Corpus Christi*
Physics-Informed Neural Networks (PINNs): A Promising Alternative to the Finite Element Method?
3:05-3:30 Lorena Aguirre-Salazar, *Texas A&M University-Corpus Christi*
An Ohta-Kawasaki model set on the space

`Session AIS1 (Student - Statistics and Data Sciences)`
Moderator: Norma Saikali .....(PLG 114)
2:40-3:00 Maytee Lagunes, *Texas A&M International University*
Machine learning has the potential to enhance clinical decision-making by predicting cardiovascular events in patients undergoing treatment with ticagrelor
3:00-3:20 Rebecca Aishwarya Namala* and S. M. Mallikarjunaiah, *Texas A&M University-Corpus Christi*
A spatiotemporal approach for real-time video anomaly detection
3:20-3:40 Rasheedat Oladoja, *Texas Tech University*
A novel approach to count data modeling: the complex tri-parametric pearson distribution and its applications
3:40-4:00 Arianna Ortiz, *Texas A&M International University*
The health benefits of physical activity
4:00-4:20 Kate Brockman*, Brian Colburn*, Joseph Garza*, and Yidong Liao*, *Texas A&M University-Corpus Christi*
Tumor progression and pharmacological intervention: modeling immunotherapeutic and chemotherapy strategies in neuroblastoma

`Session AIS2 (Student - Math Education)`

Moderator: Cesar Contreras .....(PLG 115)

2:40-3:00 Nevena Cail* and D. Palaniappan, *Texas A&M University-Corpus Christi*
Matrix approach for color corrections in solar photography

3:00-3:20 Sebastian Marcano* and Luis Molina, *Lone Star Cy Fair College*
Mexican American mathematics 2025 fall course (Lone Star College System)

3:20-3:40 Carlos Elias Montemayor Tristan, *Texas A&M International University*
Techniques to tutor math to college students

3:40-4:00 Bryan Villagomez, *Laredo Community College*
Our responsibility to Taxes

4:00-4:20 Ximena Benavides Puerto*, Jamila Moneda, Marcus Antonius Ynalvez, Claudia San Miguel, Ruby Ynalvez, Deepak Ganta, Runchang Lin, Marcela Moran, and Leonela Preciado, *Texas A&M International University*
Fostering sense belonging and persistence in STEM: the impact of a set of creative video projects (CVP) intervention on first year undergraduate STEM students

1.2.4 Afternoon Sessions-II - 4:40 P.M.–5:40 P.M.

`Session AIIS1 (Student - Applied Mathematics)`

Moderator: Saqib Hussain .....(STC 230)

4:40-5:00 Hongwei Wang, Arnold Kevin Cazares*, Jasmin Ortiz*, and Abraham Guzman Vasquez Jr.*, *Texas A&M International University*
Statistics in public health

5:00-5:20 Ricardo Saenz, *Laredo College*
Anomaly Detection, why it's important and how it's done

5:20-5:40 Cesar Ovidio Ibarra, *Laredo College*
The role of programming in applied mathematics

`Session AIIS2 (Student - Class Topics)`

Moderator: Hongwei Wang .....(STC 231)

4:40-5:00 David Cepeda, *Texas A&M International University*
The complex variable of graphic design

5:00-5:20 Jazlyn K. Gomez, *Texas A&M International University*
Pretty pictures with complex variables

5:20-5:40 Maytee Lagunes, *Texas A&M International University*
Prime and composite numbers

`Session AIIS3 (Student - Class Topics)`

Moderator: Mahanthesh Basavarajappa .....(STC 120)

4:40-5:00 Jesus Pachicano, *Texas A&M International University*
Schwarz-Christoffel mappings on irregular domains: fractal conformal geometry

5:00-5:20 Adriana Perez, *Texas A&M International University*
Complex matrices

5:20-5:40 Daniela Sandoval, *Texas A&M International University*
Branch cuts in complex analysis

`Session AIIS4 (Student - Class Topics)`
Moderator: Norma Saikali .....(PLG 114)
4:40-5:00 Leonardo San Miguel, *Texas A&M International University*
Riemann sphere
5:00-5:20 Roxana Zamora, *Texas A&M International University*
Cauchy's integral formula vs Cauchy's residue formula
5:20-5:40 Maria Fernanda Vasquez*, Hongwei Wang, Deepak Ganta, and Khaled Enab, *Texas A&M International University*
The impact of visualization and gamification in engineering and statistics classes in college

`Session AIIS5 (Student - Applied Mathematics)`
Moderator: Cesar Contreras .....(PLG 115)
4:40-5:00 Hugo Rodriguez, *Texas A&M International University*
Home Match
5:00-5:20 Mauro Guzman Jr., *Texas A&M International University*
Analyzing Optical Illusions Given Perception
5:20-5:40 Juan Carlos Nava, *Texas A&M International University*
Applications of the Mathieu Groups in Error Correction and DNA Sequencing

1.3 Schedule Grids for Presentations

1.3.1 Faculty Presentation Sessions

MORNING SESSIONS-I 9:40–11:20 A.M.

	Session MIF1	**Session MIF2**
Moderator	Saqib Hussain	Kun Gou
Room	STC 230	STC 231
9:40-10:05 A.M.	**Daniel Arias* and Sarjinder Singh**, Texas A&M University-Kingsville	**Mahanthesh Basavarajappa**, Texas A&M International University
10:05-10:30 A.M.	**Sreelekha Guggilam* and Ruhaan Singh**, Texas A&M University-Corpus Christi	**Dambaru Bhatta**, University of Texas Rio Grande Valley
10:30-10:55 A.M.	**Ahmed Al-Taweel, Saqib Hussain*, and S.M. Mallikarjunaiah**, Texas A&M International University	**Alexandr Chernyavskiy*, Barbara Prinari, D.J. Frantzeskakis, T.P. Horikis, and G.N. Koutsokostas**, Texas A&M University-Corpus Christi
10:55-11:20 A.M.	**Monique T. Cano, Aayush Mitra, Orrin D. Ware, Omar Sharif, and Michael R. Lindstrom***, University of Texas Rio Grande Valley	**Kun Gou**, Texas A&M University-San Antonio

	Session MIF3	**Session MIF4**
Moderator	Runchang Lin	Norma Saikali
Room	STC 120	PLG 114
9:40-10:05 A.M.	**Aden Ahmed**, Texas A&M University-Kingsville	**Juan Manuel Gonzalez**, St. Augustine High School
10:05-10:30 A.M.	**Leyzar Acosta**, Laredo College	**Roger Knobel**, University of Texas Rio Grande Valley
10:30-10:55 A.M.	**Zhuolin Qu* and Lauren M. Childs**, University of Texas at San Antonio	**Karla Linero-Reyes* and Alma Jasso-Chavez**, Texas A&M International University
10:55-11:20 A.M.	**Maria Vasilyeva**, Texas A&M University-Corpus Christi	**Luis C. Montemayor Garza**, Laredo ISD

MORNING SESSIONS-II 11:40 A.M.–1:20 P.M.

	Session MIIF1	**Session MIIF2**
Moderator	Saqib Hussain	Mahanthesh Basavarajappa
Room	STC 230	STC 231
11:40-12:05 P.M.	**Roberto R. Heredia* and Richard D. Hartley**, Texas A&M International niversity	**Dambaru Bhatta**, University of Texas Rio Grande Valley
12:05-12:30 P.M.	**Yifan Hsu**, Texas A&M University-Kingsville	**Gangadhara Boregowda* and Michael R. Lindstrom***, University of Texas Rio Grande Valley
12:30-12:55 P.M.	**Zhuanzhuan Ma**, University of Texas Rio Grande Valley	**Juan B. Gutiérrez**, University of Texas at San Antonio
12:55-1:20 P.M.	**Rolando Pena-Sanchez**, Texas A&M International University	

	Session MIIF3
Moderator	Runchang Lin
Room	STC 120
11:40-12:05 P.M.	**Wen-Ming He, Runchang Lin*, Tian Tian, Huayi Wei, and Zhimin Zhang**, Texas A&M International University
12:05-12:30 P.M.	**Ram Manohar* and S.M. Mallikarjunaiah**, Texas A&M University-Corpus Christi
12:30-12:55 P.M.	**Jose Morales**, University of Texas at San Antonio
12:55-1:20 P.M.	**Erwin Suazo* and Jose Escorcia**, University of Texas Rio Grande Valley

AFTERNOON SESSIONS-I 2:40 P.M.–4:20 P.M.

	Session AIF1	**Session AIF2**
Moderator	Saqib Hussain	Hongwei Wang
Room	STC 230	STC 231
2:40-3:05 P.M.	**Min Wang**, University of Texas at San Antonio	**Chris Trombley* and Sul Song**, Texas A&M University-Kingsville
3:05-3:30 P.M.	**Rolando Pena-Sanchez**, Texas A&M International University	**Tong Wu*, Humberto Godinez, Vitaliy Gyrya, and James M. Hyman**, The University of Texas at San Antonio
3:30-3:55 P.M.	**Orlando M. Patricio*, Hongwei Wang, Fernando G. Quintana, Rohitha Goonatilake, Amelia Solis, and Raonaq I. Mia**, Laredo College	**Lihua Zuo**, Texas A&M University-Corpus Christi
3:55-4:20 P.M.	**Madison De Los Santos**, Texas A&M International University	**Hongwei Wang**, Texas A&M International University
4:20-4:40 P.M.	**S. M. Mallikarjunaiah**, Texas A&M University-Corpus Christi	**Lorena Aguirre-Salazar**, Texas A&M University-Corpus Christi

	Session AIF3	**Session AIF4**
Moderator	Mahanthesh Basavarajappa	Juan J. Arellano Jr.
Room	STC 120	PLG 112
2:40-3:05 P.M.	**Hongwei Wang, Cody J. Perry*, and Saul Cardenas**, Texas A&M International University	**S. M. Mallikarjunaiah**, Texas A&M University-Corpus Christi
3:05-3:30 P.M.	**Juan Manuel Gonzalez**, St. Augustine High School	**Lorena Aguirre-Salazar**, Texas A&M University-Corpus Christi
3:30-3:55 P.M.	**Jamila Moneda*, Ximena Benavides Puerto, Marcus Antonius Ynalvez, Claudia San Miguel, Ruby Ynalvez, Deepak Ganta, Runchang Lin, Marcela Moran, and Leonela Preciado**, Texas A&M International University	

1.3.2 Student Presentation Sessions

MORNING SESSIONS-I 9:40–11:20 A.M.

	Session MIS1
Moderator	Cesar Contreras
Room	PLG 115
9:40-10:00 A.M.	**Myrine Barreiro-Arevalo*, Mike Lindstrom, and Eloi Camprubi-Casas**, University of Texas Rio Grande Valley
10:00-10:20 A.M.	**Subarna Biswas* and Devanayagam Palaniappan**, Texas A&M University-Corpus Christi
10:20-10:40 A.M.	**Kamille Garcia**, Texas A&M International University
10:40-11:00 A.M.	**Maria Pieo Fernando* and S. M. Mallikarjunaiah**, Texas A&M University-Corpus Christi
11:00-11:20 A.M.	**Joshua Lopez**, University of Texas at San Antonio

MORNING SESSIONS-II 11:40 A.M.–1:20 P.M.

	Session MIIS1	**Session MIIS2**
Moderator	Norma Saikali	Cesar Contreras
Room	PLG 114	PLG 115
11:40-12:00 P.M.	**Saugata Ghosh*, Dambaru D Bhatta, and S. M. Mallikarjunaiah**, University of Texas Rio Grande Valley	**Selina Carter* and Arun Kumar Kuchibhotla**, Carnegie Mellon University
12:00-12:20 P.M.	**Jesus A. Mendiola Herrera**, Texas A&M International University	**Jose Herrera**, Texas A&M International University
12:20-12:40 P.M.	**Ananya Gopal Hegde* and S. M. Mallikarjunaiah**, Texas A&M University-Corpus Christi	**Yejin Hwang**, Texas A&M University-Corpus Christi
12:40-1:00 P.M.	**Omar Sharif*, Blossomhill Chao, Daniel Gutierrez III, Allegra Simmons, Michael R. Lindstrom*, Tamer Oraby, and Gangadhara Boregowda***, University of Texas Rio Grande Valley	**Hermes Luna*, Deepak Ganta, Marcus Antonius Ynalvez, and Maria Lopez**, Texas A&M International University
1:00-1:20 P.M.	**Joel Williams* and Mike Lindstrom**, University of Texas Rio Grande Valley	**Ashley Marines**, Texas A&M University-Corpus Christi

AFTERNOON SESSIONS-I 2:40 P.M.–4:20 P.M.

	Session AIS1	**Session AIS2**
Moderator	Norma Saikali	Cesar Contreras
Room	PLG 114	PLG 115
2:40-3:00 P.M.	**Maytee Lagunes**, Texas A&M International University	**Nevena Cail* and D. Palaniappan**, Texas A&M University-Corpus Christi
3:00-3:20 P.M.	**Rebecca Aishwarya Namala* and S. M. Mallikarjunaiah**, Texas A&M University-Corpus Christi	**Sebastian Marcano* and Luis Molina**, Lone Star Cy Fair College
3:20-3:40 P.M.	**Rasheedat Oladoja**, Texas Tech University	**Carlos Elias Montemayor Tristan**, Texas A&M International University
3:40-4:00 P.M.	**Arianna Ortiz**, Texas A&M International University	**Bryan Villagomez**, Laredo Community College
4:00-4:20 P.M.	**Kate Brockman*, Brian Colburn*, Joseph Garza*, and Yidong Liao***, Texas A&M University-Corpus Christi	**Ximena Benavides Puerto*, Jamila Moneda, Marcus Antonius Ynalvez, Claudia San Miguel, Ruby Ynalvez, Deepak Ganta, Runchang Lin, Marcela Moran, and Leonela Preciado**, Texas A&M International University

AFTERNOON SESSIONS-II 4:40 P.M.–5:40 P.M.

	Session AIIS1	**Session AIIS2**
Moderator	Saqib Hussain	Hongwei Wang
Room	STC 230	STC 231
4:40-5:00 P.M.	**Hongwei Wang, Arnold Kevin Cazares*, Jasmin Ortiz*, and Abraham Guzman Vasquez Jr.***, Texas A&M International University	**David Cepeda**, Texas A&M International University
5:00-5:20 P.M.	**Ricardo Saenz**, Laredo College	**Jazlyn K. Gomez**, Texas A&M International University
5:20-5:40 P.M.	**Cesar Ovidio Ibarra**, Laredo College	**Maytee Lagunes**, Texas A&M International University

	Session AIIS3	**Session AIIS4**
Moderator	Mahanthesh Basavarajappa	Norma Saikali
Room	STC 120	PLG 114
4:40-5:00 P.M.	**Jesus Pachicano**, Texas A&M International University	**Leonardo San Miguel**, Texas A&M International University
5:00-5:20 P.M.	**Adriana Perez**, Texas A&M International University	**Roxana Zamora**, Texas A&M International University
5:20-5:40 P.M.	**Daniela Sandoval**, Texas A&M International University	**Maria Fernanda Vasquez*, Hongwei Wang, Deepak Ganta, and Khaled Enab**, Texas A&M International University

	Session AIIS5
Moderator	Cesar Contreras
Room	PLG 115
4:40-5:00 P.M.	**Hugo Rodriguez**, Texas A&M International University
5:00-5:20 P.M.	**Mauro Guzman Jr.**, Texas A&M International University
5:20-5:40 P.M.	**Juan Carlos Nava**, Texas A&M International University

1.3.3 Student Poster Session

MORNING SESSIONS-II 11:40 A.M.–1:20 P.M.

	Session MIIP
Moderator	Juan J. Arellano Jr.
Room	STC Ballroom
11:40-1:20 P.M.	**Roberto Arias*, Kristina Vatcheva, Vesselin Vatchev, Jesus Melgarejo, and Gladys Maestre**, University of Texas Rio Grande Valley
11:40-1:20 P.M.	**Jorge Alejandro Cuevas**, Laredo College
11:40-1:20 P.M.	**Donaldo Davila, Max Lopez, and Juan Bernal***, Laredo College
11:40-1:20 P.M.	**Andres Cabello* and Gerardo Guerrero***, Laredo College
11:40-1:20 P.M.	**Zhuolin Qu and Lauren Estrada***, University of Texas at San Antonio
11:40-1:20 P.M.	**Isaac Garay**, Texas A&M International University
11:40-1:20 P.M.	**Osvaldo Garza**, Laredo College
11:40-1:20 P.M.	**Edward Gomez Jr.**, Laredo College
11:40-1:20 P.M.	**Jeffery Opoku**, University of Texas Rio Grande Valley
11:40-1:20 P.M.	**Ben-Oni Spradlin**, University of Texas Rio Grande Valley
11:40-1:20 P.M.	**Samiha Zakir* and Kristina Vatcheva**, University of Texas Rio Grande Valley

2 List of Participants

Carnegie Mellon University

Selina Carter

Laredo College

Leyzar Acosta
Jorge Alejandro Cuevas
Edward Gomez Jr.
Maximiliano Lopez
Bryan Villagomez
Juan Bernal
Bryan Davila
Gerardo Guerrero
Orlando M. Patricio
Andres Cabello
Osvaldo Garza
Cesar Ovidio Ibarra
Ricardo Saenz

Laredo ISD

Lissette Montemayor
Luis C Montemayor Garza

Lone Star College

Cesar Flores
Sebastian Marcano
Conor Hamilton
Luis Molina
Erick Lima
Vanina Joyce Nguemsop Feutie

Prairie View A&M University

Driss Haimoud

South Texas College

Marisa Wong

St. Augustine High School

Ava Dominguez
Maria Espinoza
Juan Manuel Gonzalez
Kamila Hernandez
Camila Guerra Lopez
Alejandro Madrigal Jr.
Ana Laura McManus
Emily Meurer
Dayanara Morales
Shanaya Ortiz
Camila Pacheco
Andrea Jaime
Dariana
Disaya
Liliana
Monserrat
Roman

Texas A&M International University

Mahanthesh Basavarajappa
Ximena Benavides Puerto
Arnold Kevin Cazares
David Cepeda
Madison De Los Santos
Isaac Garay
Kamille Garcia
Jazlyn K. Gomez
Mauro Guzman Jr.
Roberto R. Heredia
Jose Herrera
Mendiola Herrera
Saqib Hussain
Maytee Lagunes
Runchang Lin
Karla Linero-Reyes
Gerardo Martinez Jesus A.
Carlos Elias Montemayor Tristan
Hermes Luna
Jamila Moneda
Juan Carlos Nava
Arianna Ortiz
Jasmin Ortiz
Jesus Pachicano
Rolando Pena-Sanchez
Adriana Perez
Cody J. Perry
Hugo Rodriguez
Daniela Sandoval
Abrahan Guzman Vasquez
Maria Fernanda Vasquez
Hongwei Wang

Texas A&M University-Corpus Christi

Lorena Aguirre-Salazar
Subarna Biswas
Kate Brockman
Nevena Cail
Alexandr Chernyavskiy
Brian Colburn
Maria Pieo Fernando
Joseph Garza
Sreelekha Guggilam
Ananya Gopal Hegde
Yejin Hwang
Yidong Liao
S.M. Mallikarjunaiah
Ram Manohar
Ashley Marines
Rebecca Aishwarya Namala
D. Palaniappan
Maria Vasilyeva
Lihua Zuo

Texas A&M University-Kingsville

Aden Ahmed
Daniel Arias
Yifan Hsu
Chris Trombley

Texas A&M University-San Antonio

Kun Gou

Texas Tech University

Rasheedat Oladoja

University of Texas Rio Grande Valley

Orune Aminul
Roberto Arias
Myrine Barreiro-Arevalo
Dambaru Bhatta
Gangadhara Boregowda
Saugata Ghosh
Roger Knobel
Mike Lindstrom
Zhuanzhuan Ma
Jeffery Opoku
Omar Sharif
Ben-Oni Spradlin
Erwin Suazo
Joel Williams
Vicente Valle
Samiha Zakir

University of Texas San Antonio

Lauren Estrada
Juan B. Gutierrez
Qiuchen Hai
Joshua Lopez
Jose Morales
Zhuolin Qu
Min Wang
Tong Wu

Unaffiliated

Fernando G. Quintana
Leonardo San Miguel
Roxana Zamora

3 Abstracts of Presentations

3.1 Faculty Presentations[1]

Leyzar Acosta, Laredo College

How Engineers Utilize Center of Mass in Every Structure [Session MIF3]

The center of mass is a physics and mathematical topic how the point of the entire mass of an object or system is considered to be concentrated for analysis. It represents the balance point where mass is evenly distributed in all directions. This mathematical concept is globally used by engineers when it comes to the safety and stability of buildings. Proper alignment of a structure's center of mass with its support system ensures balance and reduces the risk of collapse considering mother nature such as, strong winds, earthquakes, flooding, and all other factors. This presentation will cover the necessary consideration by engineers on the building's design necessary to support the foundation's stress, as well as the relationship between mass distribution and structural integrity, and real-world examples where improper mass alignment led to failures. This technique also helps ensure the engineers be mistake free. Understanding the center of mass is crucial for designing strong, supportive buildings that can withstand anything, ensuring the safety of the community, and the longevity of the structure.

JunChen Wei, Xin Yang Lu, Lorena Aguirre-Salazar*, Texas A&M University-Corpus Christi

An Ohta-Kawasaki model set on the space [Session AIF4]

We examine a non-local diffuse interface energy with Coulomb repulsion in three dimensions. Our model can be applied to the study of ionic polymers. Our model is inspired by the Thomas-Fermi-Dirac-von Weizsacker model in Quantum Physics, and the Ohta-Kawasaki model in Material Science. We consider the corresponding mass-constrained variational problem and show the existence of minimizers for small masses, and the absence of minimizers for large masses. Insights on current work will be given.

Aden Ahmed, Texas A&M University-Kingsville

Quantized Rock-Paper-Scissors: A Preliminary Report [Session MIF3]

This talk presents preliminary work on a quantization protocol for two-player, three-strategy games, with a specific application to the well-known game of Rock-Paper-Scissors.

Daniel Arias* and Sarjinder Singh, Texas A&M University-Kingsville

On Randomized Response Techniques [Session MIF1]

This presentation will begin by introducing fundamental models for randomized response techniques, outlining their key principles and protection criteria. These techniques are essential for ensuring respondent privacy while maintaining data accuracy in sensitive surveys. We will then present two newly developed models that enhance these existing methodologies.

A core focus of this discussion will be the computation of the percent relative efficiency (PRE) of the proposed models. Specifically, we will evaluate how these models perform in comparison to established techniques

[1] Presentation abstracts are sorted in the alphabetical order of presenters' names. The presenters are identified by an asterisk (*).

while maintaining an equivalent or higher level of respondent protection. By analyzing the PRE, we will assess the trade-offs between privacy and statistical efficiency, demonstrating the potential advantages of our models over their competitors.

Finally, we will explore real-world applications of these models using primary data sets. These applications will highlight the practical implications of the proposed techniques and provide empirical evidence of their effectiveness in safeguarding respondent confidentiality while preserving the integrity of collected data.

Mahanthesh Basavarajappa, Texas A&M International University

Thermal Stability Analysis of Kelvin-Voigt Fluids in Porous Media [Session MIF2]

Geothermal energy extraction involves complex fluid dynamics in porous geological formations. In this talk, we present a model investigating the stability of Darcy-Brinkman-Bénard convection in Kelvin-Voigt fluids using a local thermal non-equilibrium (LTNE) approach. We examine the onset of convection in two porous materials: Sander sandstone and aluminum metallic foam. Our methodology employs Fourier modes for linear instability analysis and the energy method for nonlinear stability analysis, with eigenvalue problems solved using the Spectral Collocation-QZ method. We present numerical results revealing a significant gap between linear and nonlinear stability thresholds, indicating a subcritical instability region. This work is conducted in collaboration with Dr. Dambaru Bhatta from The University of Texas-Rio Grande Valley.

Dambaru Bhatta, University of Texas Rio Grande Valley

Analysis of thermo-solutal convective flow in porous media [Session MIF2]

An analysis is conducted to investigate the effects of Dufour, Soret, and Lewis on thermo-solutal convective flow in porous media. Using weakly nonlinear analysis, various order systems are obtained, and these systems are solved using Runge-Kutta and Shooting methods via normal mode approach. Additionally, the amplitude equation is derived to analyze the time dependence of the solution. Numerical results for the dependent variables are presented for different parameter values.

Dambaru Bhatta, University of Texas Rio Grande Valley

Mucus transport due to ciliary movement in trachea [Session MIIF2]

Mucus is a viscous, adhesive fluid produced by various organs in the body including the nose, throat, lungs, and digestive system. Cilia, tiny hair-like structures situated in the epithelial layer of the trachea, move in a synchronized, wave-like pattern to push mucus upwards toward the throat. This mucus transport plays a crucial role in maintaining respiratory health. Using a system of partial differential equations, the mechanism of mucus transport driven by the coordinated motion of cilia is investigated in this study.

Gangadhara Boregowda* and Michael R. Lindstrom*, University of Texas Rio Grande Valley

Existence Theory: A Neuron-Centered Spatiotemporal Model of the Unfolded Protein Response in Prion Diseases [Session MIIF2]

In this talk, we introduce a neuron-focused spatiotemporal model to characterize the dynamics of the Unfolded Protein Response (UPR) mechanism in prion diseases. The model is centered around a single neuron, mathematically represented as a sufficiently smooth domain $\Omega \subset \mathbb{R}^3$, where interactions between healthy and toxic proteins follow heterodimer dynamics. This system is formulated as a coupled set of nonlinear partial differential equations, incorporating a delayed nonlinear flux boundary condition to account for the temporal evolution of protein interactions.

One of the key challenges in PDE-based real-world modeling is establishing the existence and uniqueness of solutions. To address this, we employ the method of upper and lower solutions to prove the existence of a classical, positive, and bounded solution to the model. Additionally, we demonstrate the existence of a steady-state solution, providing further insight into the long-term behavior of the system.

Alexandr Chernyavskiy*, Barbara Prinari, D.J. Frantzeskakis, T.P. Horikis,

and G.N. Koutsokostas, Texas A&M University-Corpus Christi

Dark-Bright Soliton Perturbation Theory for the Manakov System [Session MIF2]

We present a direct perturbation method to study the dynamics of dark-bright solitons of the Manakov system under the influence of perturbations. Our methodology combines a multi-scale expansion method, perturbed conservation laws and a boundary layer approach, which breaks the problem into an inner region, pertinent to the soliton core and an outer region, which evolves independently of the dark-bright soliton. We find that a shelf emerges around the dark soliton component, which propagates with a speed depending on the background intensity. Conserved quantities of the Manakov system are employed to determine the properties of the perturbed solutions. We focus on dissipative perturbations, such as diffusion, as well as linear and nonlinear loss, and show that the effect of the bright (filling) soliton component is to partially stabilize "bare" dark solitons of the scalar case against perturbation-induced dissipation. Our analytical predictions are corroborated by results of direct numerical simulations."

Madison De Los Santos, Texas A&M International University

Utilizing Machine Learning Techniques to Predict Credit Card Payment Defaults [Session AIF1]

The question of accurately predicting credit card defaulters has been explored in numerous studies in the past. In these studies, the researchers utilized various machine learning theories and techniques to make the determination the extent of defaults. Unfortunately, some constraints were encountered, and the limitations that existed from the previous works have been discussed. This project attempted to address these issues with special attention given to more recently available data. Specifically, in this project, we looked at data provided by one Kaggle user, which utilized the data from the American Express credit card competition, which ranges from late March 2018 to late October 2019, approximately 18 months. The extent of credit card defaulters was looked into using the data and used a machine learning technique, called Extremely Randomized Trees. Furthermore, a balancing technique, called Synthetic Minority Oversampling Technique, also known as SMOTE, was used to ensure the classes that were explored and balanced. Finally, the findings from the current research were compared with that of previous findings. The outcome of this project was understanding and analyzing previous research utilizing the updated available data to predict credit card payment defaults more accurately.

Juan Manuel Gonzalez, St. Augustine High School

Applications for χ-Square and Goodness-of-Fit Statistical Tests Using the TI-84 Graphing Calculator [Session MIF4]

How can you test if an experiment is fair when tossing a coin or rolling some dice? Are the expected outcomes due to chance or are they due to manipulation of the objects being used? We'll use the test known as χ-Square and Goodness-of-Fit to check the validity and reliability of such experiment, and we'll rely on the statistical features available on the TI-84 graphing calculator to simplify and expedite our work.

Juan Manuel Gonzalez, St. Augustine High School

Using Zeller's Congruence and the Greatest Integer Function to calculate the day of the week for any date in History when using the Gregorian Calendar [Session AIF3]

What day of the week were you born? What day of the week was July 4, 1776? What day of the week did Neil Armstrong first walk on the moon? We will use the Greatest Integer Function (a.k.a. the rounding down function, the step function, and the floor function) and the formula known as Zeller's Congruence to calculate the day of the week for any date in history when using the Gregorian Calendar. Zeller's congruence is an algorithm devised by Christian Zeller in the 19th century to calculate the day of the week for any Julian or Gregorian calendar date. If Zeller's Congruence is used as a step function, we could also calculate how many times has your birthday fallen on a Friday or how many times has Valentine's Day fallen on a Sunday since the day you were born.

Kun Gou, Texas A&M University-San Antonio

Study of blood flow under one-dimensional hyperelastic calcified arteries [Session MIF2]

Calcification of the arterial wall is a common result of conditions like diabetes and atherosclerosis. The impact of calcification on arterial wall deformation and the resulting hemodynamics is not fully understood. One-dimensional models of arterial blood flow offer a fast and efficient way to analyze hemodynamics, particularly when flow in non-axial directions can be ignored. We introduce a model for arterial blood flow where the tube law is derived from hyperelasticity applied to a 2D annular cross-section. We apply this model to predict hemodynamic behavior in both healthy and calcified arteries. Our findings show that calcified arteries result in a higher mean pressure gradient along the vessel. These arteries, being much stiffer than healthy ones, experience minimal deformation, leading to a larger pulse pressure.

Sreelekha Guggilam* and Ruhaan Singh, Texas A&M University-Corpus Christi

Anomaly detection based data distillation for image processing [Session MIF1]

Deep learning models have proven to be effective on medical datasets for accurate diagnostic predictions from images. However, training deep neural networks on relatively smaller samples could pose over-fitting issues and result in model that can be vulnerable to rare patterns. This in particular, could pose serious risks in medical diagnostics where the risk associated with mis-classification can impact human life. Many training approaches like curriculum learning has been explored in the past that attempt to optimize the training of neural networks by sequentially increasing the difficulty of training samples. However, there persists the challenge of a generalizable approach that can rank the difficult of training samples which can be applicable across domains, datasets, models and tasks. In this paper, we propose a novel training approach Iterative Misclassification Error Training IMET, inspired from curriculum learning, that determines the difficult or challenging samples for training the neural network at each epoch.

Juan B. Gutiérrez, University of Texas at San Antonio

Monomial Activation Functions for Artificial Neural Networks [Session MIIF2]

Monomial activation functions provide a structured and theoretically grounded alternative to traditional activation functions in artificial neural networks. While deep learning has achieved remarkable success across various applications, the challenge of selecting and training optimal activation functions persists. This talk introduces a novel neural network design, SWAG, which employs polynomial activation functions instead of evolving functions. Each hidden layer in this architecture consists of multiple sub-layers using polynomial activations scaled by factorial coefficients, followed by concatenation and a linear activation layer. By leveraging the Stone-Weierstrass approximation theorem, this approach ensures that neural networks maintain universal approximation capabilities. Additionally, an optimized version of SWAG is presented, reducing computational complexity by efficiently computing higher-degree terms using lower-degree Taylor series expansions. This framework offers an alternative to conventional activation functions and aims to enhance both efficiency and robustness in deep learning architectures.

Roberto R. Heredia* and Richard D. Hartley, Texas A&M International University

The Statistical Truth in Social Behavioral Statistics [Session MIIF1]

In this presentation, we provide a general overview of our recently published Social Behavioral Statistics book. We specifically focus on conceptual understanding by emphasizing definitional formulas and the path to the truth, through the hypothesis testing process.

Yifan Hsu, Texas A&M University-Kingsville

Integrating AI into imbalanced data learning [Session MIIF1]

Imbalanced data is a prevalent challenge in machine learning, particularly in applications such as fraud detection,

medical diagnosis, and anomaly detection. Traditional machine learning algorithms often struggle with skewed class distributions, leading to biased models that favor majority classes. To address this issue, generating synthetic data algorithms have been developed. This presentation will introducing key approaches such as Synthetic Minority Over-sampling Technique (SMOTE), Random Over-Sampling Examples (ROSE), and explore the integration of artificial intelligence (AI) with imbalanced data learning as Autoencoders, and Generative Adversarial Networks (GANs). Experimental results demonstrate that integrating these methods improves classification performance, leading to more robust and fair machine learning models.

Ahmed Al-Taweel, Saqib Hussain*, and S.M. Mallikarjunaiah, Texas A&M International University

Analyzing mob dynamics in social media networks using epidemiology model [Session MIF1]

Epidemiological models, traditionally used to study disease spread, can effectively analyze mob behavior on social media by treating ideas, sentiments, or behaviors as contagions that propagate through user networks. In this research, we introduced a mathematical model to analyze social behavior related to COVID-19 spread by examining Twitter activity from April 2020 to June 2020. Our analysis focused on key terms such as lockdown and quarantine to track public sentiment and engagement trends during the pandemic. The threshold number 0 is derived, and the stability of the steady states is established. Numerical simulations and sensitivity analysis of applicable parameters are carried out. The results show that negative sentiment on Twitter has less influence on COVID-19 spread compared to positive sentiment. However, the effect of negative sentiment on the spread of COVID-19 remains remarkably strong. Moreover, we use the Caputo operator with different parameter values to study the impact of social media platforms on the transmission of COVID-19 diseases.

Roger Knobel, University of Texas Rio Grande Valley

Engaging Secondary Teachers in Doing Mathematics [Session MIF4]

In a joint project with the McAllen Independent School District, summer math camps were run by middle and high school teachers for students entering district high schools. Parallel to the student camp was a math camp for teachers in which teachers explored advanced concepts related to the student activities they were leading. In this talk, selected activities from the teacher math camp are presented along with their connection to the student activities.

Monique T. Cano, Aayush Mitra, Orrin D. Ware, Omar Sharif, and Michael R. Lindstrom*, University of Texas Rio Grande Valley

Data-driven study of mental health disorders: identifying patterns in substance use problems and mental health disorders [Session MIF1]

Prior research has shown that there are links between mental health disorders and substance use disorders, as well as multimorbidity between various mental health disorders. In this presentation, we examine the 2020 SAMHSA Mental Health Client-Level Data, focusing on psychiatric outpatients aged 18-64, resulting in a sample of approximately 3 million patients across the United States. Patients were diagnosed with 1-3 disorder groupings: Anxiety, Depression, Trauma, ADHD, Bipolar, Schizophrenia, Personality, and Substance Use. To study multimorbidity clusters, we employ a Mixture of Bernoulli model to group patients into clusters with differing risk profiles for different disorder groupings, and we use eigenvector centrality to heuristically identify the most important disorders. We then consider differences across states by examining the disorder prevalences among outpatients within each state, and we employ Functional Kernel Density Estimation to identify anomalous trends across age groups between states. We find that substance use disorders are the most central, and that substance use is also common across multimorbidity clusters. There are also pronounced differences across states in the trends and prevalences of disorder groupings, suggesting the possibility of regionally dependent diagnostic criteria.

Wen-Ming He, Runchang Lin*, Tian Tian, Huayi Wei, and Zhimin Zhang, Texas A&M International University

Richardson extrapolation for C^0 interior penalty finite element method for biharmonic problems [Session MIIF3]

In this work, we present a novel Richardson extrapolation operator R^k to investigate the local ultraconvergence of kth order ($k \geq 2$) C^0 interior penalty finite element approximations for biharmonic problems. Using some estimates for the discrete Green's function of the differential equation established in this article, we obtain that the Richardson extrapolation operator R^k will yields $k-1$ extra order of accuracy beyond the optimal rate. Numerical experiments have been provided to confirm theoretical findings.

Karla Linero-Reyes* and Alma Jasso-Chavez, Texas A&M International University

Expanding Corequisite Mathematics Success: Leveraging the CRSM Grants for Institutional Transformation [Session MIF4]

Developmental mathematics remains a critical barrier to student persistence and degree completion. The College Readiness and Success Model (CRSM) Grant provides institutions with targeted funding to enhance corequisite mathematics models, ensuring students enroll directly in credit-bearing courses with embedded support. This presentation highlights how Texas A&M International University strategically utilized CRSM funding to implement data-driven curriculum enhancements, faculty professional development, and holistic student support structures.

Our approach includes aligning corequisite course objectives with math credit bearing pathways, integrating evidence-based instructional strategies and leveraging technology for personalized learning. Additionally, we have established faculty training workshops and equity-driven advising practices to increase student engagement and retention. Preliminary data indicate a measurable increase in student success rates, persistence, and math confidence, reinforcing the efficacy of our CRSM-supported initiatives.

This presentation will share insights on effective grant implementation, challenges faced, and sustainable strategies for institutions looking to enhance their own corequisite mathematics programs. By fostering institutional collaboration and leveraging state-level resources, we aim to create a lasting impact on student achievement and equitable access to mathematics education.

Zhuanzhuan Ma, University of Texas Rio Grande Valley

Bayesian nonparametric hypothesis testing methods on multiple comparisons [Session MIIF1]

In this presentation, we introduce Bayesian testing procedures based on the Bayes factor to compare the means across multiple populations in classical nonparametric contexts. The proposed Bayesian methods are designed to maximize the probability of rejecting the null hypothesis when the Bayes factor exceeds a specified evidence threshold. It is shown that these procedures have straightforward closed-form expressions based on classical nonparametric test statistics and their corresponding critical values, allowing for easy computation. We also demonstrate that they effectively control Type I error and enable researchers to make consistent decisions aligned with both frequentist and Bayesian approaches, provided that the evidence threshold for the Bayesian methods is set according to the significance level of the frequentist tests. Importantly, the proposed approaches allow for the quantification of evidence from empirical data in favor of the null hypothesis, an advantage that frequentist methods lack, as they cannot quantify support for the null when the null hypothesis is not rejected. We also present simulation studies and real-world applications to illustrate the performance of the proposed testing procedures.

S. M. Mallikarjunaiah, Texas A&M University-Corpus Christi

Physics-Informed Neural Networks (PINNs): A Promising Alternative to the Finite Element Method? [Session AIF4]

Partial differential equations (PDEs) are essential tools for modeling in physics, chemistry, biology, and engineering. To accurately simulate these processes and systems, the solutions to PDEs frequently necessitate the application of numerical approximation techniques. The finite element method, for example, is widely employed as a conventional approach for this objective. Recent advancements in deep neural networks regarding various approximation tasks have motivated their integration into the numerical solutions of PDEs. Physics-informed neural networks (PINNs), along with their variants, have

exhibited proficiency in approximating a diverse range of PDEs. To date, the exploration of physics-informed neural networks in conjunction with the finite element method has largely occurred in isolation. This study aspires to conduct a comparative analysis of these methodologies through a systematic computational investigation. Specifically, both techniques will numerically resolve an array of linear and nonlinear PDEs. A comparative analysis addressing computational costs and approximation accuracies will be presented for several test examples.

This material is based upon work supported by the National Science Foundation under Grant No 2316905.

Ram Manohar* and S.M. Mallikarjunaiah, Texas A&M University-Corpus Christi

Discontinuous Galerkin Methods for Quasi-Static Boundary Value Problems: Newton Linearization and Error Analysis [Session MIIF3]

In this talk, we present the development of an *hp*-local discontinuous Galerkin finite element method for approximating the solution of quasi-static boundary value problems, employing Newton's method for linearization. These types of problems arise in modeling geometrically linear elastic bodies with algebraically nonlinear constitutive relationships. Using Riesz representation theory, we establish the existence of a unique discrete solution. Furthermore, we discuss a priori error estimates in the energy norm for sufficiently small h and appropriately chosen polynomial degrees. Finally, we showcase a numerical example that demonstrates the efficiency of the proposed method, particularly in modeling crack-tip stresses and strains in materials under anti-plane shear.

Jamila Moneda*, Ximena Benavides Puerto, Marcus Antonius Ynalvez, Claudia San Miguel, Ruby Ynalvez, Deepak Ganta, Runchang Lin, Marcela Moran, and Leonela Preciado, Texas A&M International University

Exploring Psychosocial Outcomes in First-Year Undergraduate STEM Students: The Impact of a Set of Creative Video Projects (CVP) Intervention on STEM-Efficacy and STEM-Identity [Session AIF3]

With the rising demand for professionals in STEM fields, there is a shortage of undergraduate students pursuing STEM careers. Previous studies show psychosocial outcomes (PSOs) like STEM efficacy (STEMSE) and STEM identity (STEMSI) are key predictors of STEM interest and retention. In this study, we examine how a STEM-enrichment program (USTEM) impacts first-year undergraduates' STEMSE and STEMSI. Three annual cohorts (Cohort 1, n=40; Cohort 2, n=30; Cohort 3, n=41) were assessed. Each cohort was divided with participants randomized into two comparison groups: USTEM1 (without CVPs), USTEM2 (with CVPs). We predict that USTEM2 students will show significantly higher STEMSE and STEMSI.

Students were assessed at five points: baseline (M1), end of precollege summer (M2), end of freshman fall (M3), spring (M4), and summer (M5) using online surveys with items on a 7-point Likert scale. Items 1-7 pertained to STEMSE; Items 8-11 pertained to STEMSI. Principal component analyses identified two dimensions for STEMSE-academic STEM-efficacy (ASESTEM) and STEM-task-efficacy (STEMTaskSE)-and two for STEMSI-self-concept (STEMSIC) and affinity (STEMSIA). Binary logistic regression evaluated "high" or "low" classifications for STEMSE, STEMSI, and their components. Multinomial logistic regression analyzed "high" and "low" combinations (e.g., "high-high", "high-low", etc.) across STEMSE and STEMSI (SESI), ASESTEM and STEMTaskSE (ATSE), and STEMSIC and STEMSIA (CASI).

For self-efficacy, USTEM2 participants had significantly (p¡.05) higher STEMSE and ASESTEM outcomes, with no difference in STEMTaskSE. For self-identity, males significantly outperformed females (p¡.05) in STEMSI and STEMSIA, but not in STEMSIC. For STEMSI, group by gender interaction revealed higher male scores in USTEM1 and higher female scores in USTEM2. Additionally, USTEM2 participants were more likely to exhibit "high-high" SESI and "high-high" ATSE combinations. Our results have important implications in designing intervention programs that target psychosocial outcomes in STEM.

Luis C. Montemayor Garza, Laredo ISD

How to teach Algebra to Students with Learning Disabilities [Session MIF4]

Teaching algebra to students with learning disabilities requires a multifaceted approach that incorporates various techniques to ensure academic success. This abstract outlines effective methods and strategies for teaching algebra to students with learning disabilities, highlighting the importance of differentiated instruction and accommodations.

Key Idea: The key idea is to provide a supportive and inclusive learning environment that caters to the diverse needs of students with learning disabilities. By acknowl-

edging and addressing individual learning styles, teachers can facilitate a deeper understanding of algebraic concepts and promote academic achievement.

Methods: Effective techniques for teaching algebra to students with learning disabilities include:

1. Multisensory instruction: Using visual, auditory, and kinesthetic approaches to engage students and enhance understanding.

2. Assistive technology: Utilizing digital tools, such as graphing calculators and math software, to facilitate learning and provide accommodations.

3. Graphic organizers: Employing visual aids to help students organize and connect algebraic concepts.

4. Differentiated instruction: Tailoring lessons to meet individual needs, including providing extra support and practice.

Conclusion: By incorporating these techniques into algebra instruction, teachers can create a supportive and inclusive learning environment that fosters academic success for students with learning disabilities. By acknowledging and addressing individual learning needs, educators can empower students to overcome challenges and develop a deeper understanding of algebraic concepts.

Jose Morales, University of Texas at San Antonio

Computational Methods for Quantum and Semiclassical Kinetic Equations [Session MIIF3]

My group works in the broad research lines of mathematical and computational methods for the study of kinetic equations modeling phenomena such as electron transport in semiconductors and open quantum systems, which are then solved through different numerical methods, either deterministic or stochastic. The aforementioned equations can study the respective physical phenomena at either a semi-classical level (for example, via a Boltzmann equation) or a quantum scale (for example, via a density matrix or a Wigner model). Some specific research topics are the development of Discontinuous Galerkin methods for the Boltzmann model of electrons in semiconductors, the study of numerical boundary conditions for Galerkin methods analog to the analytical ones for the reflection over rough boundaries, the homogenization of boundary layers in Boltzmann-Poisson, uncertainty quantification through Stochastic Galerkin techniques, as well as the study of open quantum systems by different computational methods: Discontinuous Galerkin with either polynomial or non-polynomial bases, Monte Carlo Methods, as well as Physics-Informed Neural Networks.

Orlando M. Patricio*, Hongwei Wang, Fernando G. Quintana, Rohitha Goonatilake, Amelia Solis, and Raonaq I. Mia, Laredo College

Epidemiological Models of Murine Typhus in South Texas [Session AIF1]

This study aims to investigate statistically if there is a causality for the murine typhus endemic disease related to precipitation, temperature and the natural cycle of flea development in South Texas. Path analysis was used to determine the mediating and moderating variables that cause murine typhus disease. Three path diagram models were tested. Model 3 shows a clearer path on how the Rickettsia fleas were transmitted to the patients or subject, where rate of flea development is a mediating variable between sources of transmission and disease contraction, whereas precipitation moderates the source of transmission on its effect on rate of flea development with fleas in the environment and temperature average as covariates. The results of the path analysis support this hypothesis. Graphical research indicates that the number of murine typhus cases reaches a maximum during the month of May, when the temperature is between 65-80°F with about 70% humidity for flea development and the precipitation increases the probability that bacteria, fleas and hosts get in contact with humans. The results of this research suggest that the Laredo population should be made aware that the presence of rickettsia-infected Xenopsyllia cheopis and Ctenocephalides felis, the development of environmental conditions that increase the possibility of contact of wild and domestic animals with human beings can also increase the possibilities of the manifestation of the disease.

Rolando Pena-Sanchez, Texas A&M International University

Nonparametric Statistical Comparison of Unemployment in the US, Mexico and Canada [Session MIIF1]

In this article we analyze almost the last 33 years (1991-

2023) of unemployment as % of the total labor force in the United States, Mexico, and Canada, which are country members of the new US-MEXICO-CANADA (USMCA) trade agreement, treaty that replaced the North American Free Trade Agreement since July 1, 2020. The role of macroeconomic indicators such as gross domestic products, inflation, interest rates and exchange currency in determining unemployment levels. Economic investments in education and training are strategies to provide people with the skills necessary to succeed in a variety of sectors. The essay proposes diverse strategies for reducing unemployment, including stimulating economic growth, attracting foreign investment, providing tax incentives and subsidies to small and medium-sized enterprises, and designing tax regulations to encourage businesses to invest in their workforce's skills. A nonparametric comparison of unemployment distributions was conducted, whose selection is explained by means of the Levene's statistic, and a relative ranking of unemployment level (high, medium, and low) was assigned.

Rolando Pena-Sanchez, Texas A&M International University

Statistical Curvilinear Regression of CO2 per GDP in the US, China, Japan, Germany and India [Session AIF1]

This research article contains an analysis of the global carbon dioxide (CO2) trend among the current five great titans of the world economy (United States, China, Germany, Japan, and India); and we review how these countries are contributing to the production of greenhouse gases, where we can interpret CO2 per Gross Domestic Product (GDP) by country as a measure of environmental/economic risk density for the mentioned countries during 1990-2021; from which some curvilinear relationships were measured through regression analysis, and homogeneous blocks with similar density were identified through a parametric analysis of variance (ANOVA) and a nonparametric statistical technique (Kruskal-Wallis test), where both methodologies generated the same conclusions.

Hongwei Wang, Cody J. Perry*, and Saul Cardenas, Texas A&M International University

How Does Education Impact a Family's Overall Well-being and Quality of Life [Session AIF3]

Collecting data from 292 students, we analyzed the impact of education on Hispanic families' well-being and quality of life. We found that those whose parents were involved more in their education and who encountered more barriers or challenges were likelier to feel that their quality of life would improve as their educational attainment increased. This study highlights the importance of parent involvement and indicates that the college-age population is adept at overcoming obstacles and barriers.

Zhuolin Qu* and Lauren M. Childs, University of Texas at San Antonio

Assessing the impact of the Wolbachia-based control of malaria [Session MIF3]

Malaria remains a significant infectious disease globally, causing hundreds of thousands of deaths each year. Traditional control methods, such as disease surveillance and mosquito control, along with the development of malaria vaccines, have made strides in reducing the disease's impact, but new control methods are urgently needed. Wolbachia is a natural bacterium that can infect mosquitoes and reduce their ability to transmit diseases. While initially used to control dengue fever, recent research explored its potential for malaria control. In this study, we develop and analyze a novel mathematical model to assess the potential use of Wolbachia-based strategies for malaria control. The model describes the complex Wolbachia transmission dynamics among mosquitoes and incorporates key features of malaria transmission in humans with dynamical immunity feedback. We derive the basic reproduction number of the malaria disease transmission, which depends on the prevalence of Wolbachia in mosquitoes. Our findings reveal bifurcations in both Wolbachia transmission among mosquitoes and malaria transmission in humans, suggesting the potential for malaria elimination through Wolbachia-based interventions. The sensitivity analysis identifies the important parameters for the basic reproduction number and for malaria reduction and elimination. We numerically explore the integration of Wolbachia and other malaria

controls. When control focuses on reducing the malaria burden in humans, there is a substantial rebound in malaria prevalence following the intervention in humans, and our results suggest post-Wolbachia malaria control leads to the greatest reduction in total days of infection. When Wolbachia release is integrated with pre-release mosquito control, there is a comparably large reduction in total days of infection if pre-release mosquito control occurs only a few days before Wolbachia release.

Erwin Suazo* and Jose Escorcia, University of Texas Rio Grande Valley

Explicit solutions for nonlinear PDEs systems with variable coefficients [Session MIIF3]

This work is concerned with the study of explicit solutions for a generalized coupled nonlinear Schrödinger equations (NLS) system with variable coefficients. Indeed, by employing similarity transformations, we show the existence of rogue wave and dark–bright soliton-like solutions for such a generalized NLS system, provided the coefficients satisfy a Riccati system. As a result of the multiparameter solution of the Riccati system, the nonlinear dynamics of the solution can be controlled. Finite-time singular solutions in the L_∞ norm for the generalized coupled NLS system are presented explicitly. Finally, an n-dimensional transformation between a variable coefficient NLS coupled system and a constant coupled system coefficient is presented. Soliton and rogue wave solutions for this high-dimensional system are presented as well.

Chris Trombley* and Sul Song, Texas A&M University-Kingsville

Existence and Regularity for Compressible and Barotropic Unsteady Stokes Flows [Session AIF2]

The partial differential equations for a compressible and barotropic unsteady Stokes flow are examined from the point of view of existence and regularity. Due to barotropy and compressibility, the system is nonlinear in fluid density. We take as data the value of the density at a spatial point in the domain, the divergence of velocity and the initial value of the velocity. We create sequences of linearized partial differential equations and use Galerkin's method to convert the linearized equations in to systems of ordinary differential equations. Using Sobolev space techniques, we prove the existence of a unique solution to the system of equations under periodic boundary conditions for a finite time interval under certain conditions.

Maria Vasilyeva, Texas A&M University-Corpus Christi

Coarse grid approximation and two-grid preconditioner for problems in heterogeneous domain [Session MIF3]

We present the construction of an accurate coarse grid approximation for problems in heterogeneous domains. The method is based on constructing multiscale space by solving local problems in overlapped domains. We discuss the application of the multiscale space in constructing the efficient two-grid preconditioner. The choice of smoothing iterations is investigated. We apply the proposed algorithm to solve the mixed-dimensional flow in fractured porous media and anisotropic heat flow with a high level of anisotropy.

Hongwei Wang, Texas A&M International University

A Three-Dimensional Approach to Nutrition: Mapping Daily Meals Using XYZ Coordinates [Session AIF2]

While Mathematics and nutrition play a vital role in real life, our review of the literature on both Mathematics and nutrition education revealed the following knowledge gaps: 1) Lack of data literacy or foundational knowledge to understand, manipulate and visualize data; 2) Disconnect in Mathematics theory taught and real-world applications in healthy eating, and 3) Lack of structured nutrition program for South Texas Hispanic population. Mathematics plays a crucial role in nutrition science by providing quantitative methods for analyzing dietary intake, optimizing meal planning, and assessing health outcomes. Mathematical concepts, including three-dimensional coordinate systems, can be creatively applied to optimize daily meal planning and nutrient balance. This presentation explores how mathematical models and statistical techniques are used to evaluate nutrient consumption, balance macronutrient intake, and

predict health risks related to diet. We explore how the XYZ coordinate system can represent three key aspects of a meal: X (Macronutrients: Complex Carbohydrates), Y (Macronutrients: Proteins), and Z (Macronutrients: Fiber). By visualizing meals in a three-dimensional space, individuals can balance their diet by adjusting their intake along these axes, ensuring adequate nutrition while avoiding deficiencies or excesses. We will discuss applications of this model in meal planning, dietary tracking, and personalized nutrition strategies. This innovative mathematical framework provides a structured yet flexible approach to achieving dietary balance and overall health. By integrating mathematics into nutrition studies, researchers and health professionals can develop more precise dietary guidelines and interventions to promote overall well-being.

Min Wang, University of Texas at San Antonio

Double-robust Bayesian variable selection and model prediction with spherically symmetric errors [`Session AIF1`]

esponse surface methodology has been known as an effective tool for improving an overall manufacturing process where quality requirements are fulfilled. This work proposes a double-robust Bayesian modeling method that can simultaneously cope with variable selection, model form uncertainty, and non-normality for quality prediction. Double robustness is achieved by specifying the class of spherically symmetric distributions for the errors and accounting for model form uncertainty through Bayesian model averaging. Furthermore, with a special choice in the sub-harmonic priors for the regression coefficients, a closed-form expression of the marginal posterior distribution of each candidate model is obtained, which is not only free of the error distributions (other than spherical symmetry) but also can be easily computed using standard software. To provide a better interpretation of the model, a special prior is specified for the model space to maintain and reflect the hierarchical or structural relationships among input variables. The proposed Bayesian method has the properties of variable selection consistency and prediction consistency under Bayesian model averaging. Through numerical experiments and a case study, the proposed double-robust Bayesian modeling method is shown to achieve results superior to those of the existing established methods in prediction and variable selection in linear models under different types of error distributions.

Tong Wu*, Humberto Godinez, Vitaliy Gyrya, and James M. Hyman, The University of Texas at San Antonio

Interpolated Discrepancy Data Assimilation for PDEs with Sparse Observations [`Session AIF2`]

We present the Interpolated Discrepancy Data Assimilation (IDDA) method, a novel approach for continuous data assimilation in systems governed by partial differential equations (PDEs). IDDA addresses the challenges of sparse and unevenly distributed observational data by dynamically adjusting feedback controls based on the discrepancies between observed and modeled states. Extending the Azouani-Olson-Titi framework, our method refines the assimilation process by incorporating a forcing term constructed from interpolants of both the observational sample and the assimilated solution at observation points. Additionally, IDDA introduces a new correction to nonlinear terms, enhancing the stability and accuracy of the assimilation process. We demonstrate the effectiveness of IDDA through numerical experiments on benchmark PDEs, including the Kuramoto-Sivashinsky, 2-D Navier-Stokes equations, and shallow water models with bottom topography.

Lihua Zuo, Texas A&M University-Corpus Christi

Pressure and rate analysis for shale gas reservoirs using anomalous diffusions [`Session AIF2`]

In the past decade, plenty field data have shown that the fluid dynamics in porous media might be better simulated by the anomalous diffusion. In this study, the time fractional diffusion equation is used to model the shale gas flow in shale gas reservoirs. A new fractional diffusion equation is proposed by considering most of the physical parameters in the equation. First, the analytical kernel function is derived and analyzed. Then, the numerical solution is obtained by a well-designed finite difference

scheme, and the numerical method is validated with the known analytical solution. Finally, different fractional orders are tested to show the impact of the fractional order on the pressure and flow rates. The results of this study could build a solid foundation for future application of anomalous diffusions in porous media.

3.2 Student Presentations

Myrine Barreiro-Arevalo*, Mike Lindstrom, and Eloi Camprubi-Casas, University of Texas Rio Grande Valley

Synthesis and characterization of vesicle compartments to study the origins of heredity [Session MIS1]

The exploration of life's origins confronts the enigma of cellular components' genesis and assembly. Historically, the "RNA World" hypothesis dominated, positing life started with self-replicating RNA molecules that eventually developed all biological functions. This concept emphasizes the necessity of a hereditary mechanism for evolution. Despite its significance, no laboratory has yet synthesized a self-replicating RNA, leaving this hypothesis unverified. As an alternative, the "metabolism-first" hypothesis suggests life began from networks of autocatalytic reactions rather than individual RNA molecules, with these networks potentially enabling a primitive form of inheritance through chemical compositions, like lipid membrane makeup, predating genetic biopolymers. This project investigates heredity within vesicle-based protocells and the engineering of molecular systems for liposome production. This interdisciplinary venture combines synthetic biology and molecular engineering, utilizing mathematical models of autocatalytic chemical systems (ACS) to probe the mechanics of self-replication. Our focus is on how self-assembling lipids might have facilitated the reproduction of early cell-like structures, offering a new perspective on life's emergence that aligns with the metabolism-first theory. We aim to identify the most stable lipids for vesicles and employ an image-recognition algorithm for vesicle quantification, contributing to our understanding of early biological evolution.

Ximena Benavides Puerto*, Jamila Moneda, Marcus Antonius Ynalvez, Claudia San Miguel, Ruby Ynalvez, Deepak Ganta, Runchang Lin, Marcela Moran, and Leonela Preciado, Texas A&M International University

Fostering Sense Belonging and Persistence in STEM: The Impact of a Set of Creative Video Projects (CVP) Intervention on First Year Undergraduate STEM Students [Session AIS2]

The declining number of students pursuing STEM careers poses a significant challenge to the demand for STEM-related professionals and scientific innovation. Extant literature shows that psychosocial outcomes (PSOs) such as STEM sense of belonging and persistence strongly influence interest and retention. Our study examines how an originally designed first-year college STEM-enhancement program called USTEM enhances students' STEM sense of belonging (STEMSB) and STEM Persistence (STEMP).

Three annual cohorts (Cohort 1, n=40; Cohort 2, n=30; Cohort 3, n=41) were evaluated with student-participants randomized into two comparison groups: USTEM1 (without CVPs) and USTEM2 (with CVPs). Each cohort was processed over four semesters (precollege summer, freshman fall, spring, and summer). We hypothesize that STEMSB is strongly positively associated with STEMP, but there is a component of STEMSB that has the highest association with STEMP; and USTEM2 will have significantly higher PSOs compared to USTEM1.

Students were evaluated at five time points: baseline (M1) and the end of each subsequent semester (M2-M5) using online surveys comprising 34 items rated on a 7-point Likert scale (1-strongly disagree to 7-strongly agree). Items 12-29 were used to measure STEMSB, while items 30-34 measured STEMP. A principal component analysis on STEMSB retained three components and these were labeled: inclusion (STEMSBI), validation (STEMSBV), and comfort (STEMSBC). STEMP had only one component.

Using binary and multinomial logistic regression and controlling for cohort, measurement (M1-M5), and gender effects, we assessed the impact of comparison groups on STEMSBI, STEMSBV, STEMSBC, and STEMP. Further analyses include STEMSBI, STEMSBV, STEMSBC as predictors of STEMP. Our results indicate that: 1) USTEM2 was associated with better PSOs (overall sense of belonging, and its inclusion and validation dimensions; and persistence); 2) all components of overall sense of belonging are strongly linked to persistence; and 3) of these components, inclusion was the most important predictor.

Subarna Biswas* and Devanayagam Palaniappan, Texas A&M University-Corpus Christi

Analytical solutions for two-dimensional oscillatory flows with velocity slip [Session MIS1]

Understanding of unsteady slow viscous flows in the presence of body profiles is critical in various biological and chemical phenomena such as microorganism swimming, blood flow, and Brownian motion. This presentation examines the motion of two-dimensional slow oscillatory flows around a cylindrical geometry, where time dependency and slip conditions add complexity. The first slip condition to be discussed in this talk, the Navier-slip condition, applies to gas-surface interactions near the object's walls, while the second is commonly used in studies on microorganism swimming behavior. Exact solutions to the fourth-order boundary value problem (BVP) are derived using the Lagrange stream function $\Psi(r, \theta)$. These solutions demonstrate how slip parameters influence eddy structures at various times. The key characteristics of the flow field and their implications using streamline plots will be shown as well.

Omar Sharif*, Blossomhill Chao, Daniel Gutierrez III, Allegra Simmons, Michael R. Lindstrom*, Tamer Oraby, and Gangadhara Boregowda*, University of Texas Rio Grande Valley

Deterministic and Stochastic Models of Prion Protein Misfolding: Implications for Disease Progression and Intervention Strategies [Session MIIS1]

A prion disease is a type of neurodegenerative disorder caused by the misfolding of cellular prion protein (PrP^C) into Scrapie prion protein (PrP^{Sc}), leading to neuronal stress and cell death. Neuronal stress activates the unfolded protein response (UPR), which slows protein translation. Understanding the dynamics of this disease is crucial for the development of its treatment. This work introduces a time-delayed stochastic model to describe the concentration dynamics of Scrapie proteins at the neuronal level, incorporating the effects of the UPR. We study our model through analysis and numerical simulation. We also determine conditions for disease persistence and extinction. Simulation results validate our theoretical findings. Stability analysis identifies the conditions under which disease extinction occurs in our model. Building upon this, we analyze our stochastic system to demonstrate its global exponential stability concerning both toxicity extinction and persistence. We found out that an initially persisting prion disease (in a deterministic model) could be eradicated by including a sufficient level of white noise.

Kate Brockman*, Brian Colburn*, Joseph Garza*, and Yidong Liao*, Texas A&M University-Corpus Christi

Tumor Progression and Pharmacological Intervention: Modeling Immunotherapeutic and Chemotherapy Strategies in Neuroblastoma [Session AIS1]

Neuroblastoma, the most common solid tumor causing cancer in infants, remains a leading cause of childhood cancer-related mortality. Despite advances in treatment, there is an ongoing need for more effective mathematical models and therapies to improve outcomes across neuroblastoma-specific patient populations. Immunotherapy and chemotherapy, particularly the use of Interleukin-2 (IL-2) and Cyclophosphamide, have shown promising therapeutic effects by enhancing immune responses and targeting cancer cells. Hence, this study developed a coupled, nonlinear system of first-order differential equations to model the immune-cellular dynamics of neuroblastoma progression. The mathematical model captured the interactions between tumor cells, natural killer cells (NK), and cytotoxic T lymphocytes (CTLs), while exploring how IL-2 and Cyclophosphamide influenced these dynamics. The research explored cancer cell population dynamics in the absence of treatment across low-risk, medium-risk, and high-risk patient populations and evaluated the effects of IL-2 and Cyclophosphamide on tumor progression. The analysis focused on the immune-cellular dynamics and cancer progression under various treatment conditions, examining how two common drugs used for the treatment of neuroblastoma influenced tumor growth and immune response in patients. Our modeling approach aims to optimize immunotherapeutic and chemotherapy strategies, offering valuable insights for improving clinical outcomes in neu-

roblastoma treatment.

Nevena Cail* and D. Palaniappan, Texas A&M University-Corpus Christi

Matrix Approach for Color Corrections in Solar Photography [Session AIS2]

In this talk, we discuss formulating methods using matrix transformations to convert grayscale images directly into RGB, with a special interest in applying these techniques to solar photography. Solar photography is typically done in black and white, and imbued with color in post-processing by adjustment of color curves in image editors. We are interested in revealing a more sophisticated or customizable coloring method using basic linear algebra tools. Any grayscale value can map into many RGB values, so the conversion from gray to RGB is not a straightforward recovery of lost information. Our method of deriving a color correction matrix (CCM) was to use prior knowledge such as color chart patches which matched gray values with known RGB values. However, this method was limited to a least squares solution, which averaged between all the gray-color mappings to produce a gray output. Addressing this problem was to increase the dimensionality of the matrices used to solve each row of CCM coefficients. Regardless of how these are formed, the resulting CCM is only ever capable of a tinting effect, since the target of the CCM is a scalar value which spans a one-dimensional subspace of RGB space. Thus, all gray values lie on a line in RGB space in the direction of $(1, 1, 1)^T$. Therefore, we propose using a gray-color pair interpolation map prior to applying a CCM to make specific coloration customization possible. Development of an application to customize coloration parameters in both the interpolation map and CCM, and as a tool for investigating how the color transformation methods work in practice will also be presented. This work was funded by the Louis Stokes Alliance for Minority Participation for undergraduates under the National Science Foundation.

Selina Carter* and Arun Kumar Kuchibhotla, Carnegie Mellon University

Inference for Online Algorithms without Variance Estimation [Session MIIS2]

Inference for online algorithms is a difficult problem because estimation of asymptotic variance can inflate the computational cost. Previous works have proposed online estimation of the covariance matrix as well as batching methods to construct confidence intervals. In this work, we propose the use of the recently developed HulC procedure for uncertainty quantification in the online setting. The highlights of this procedure include: no inflation in the computational cost; no estimation of the asymptotic variance; and asymptotically exact coverage.

We compare the performance of this procedure with those of previous works in the context of linear and logistic regression over a wide range of covariance settings and dimension-aspect ratios. Our main finding is that we get comparable or better coverage properties compared to the methods that estimate the asymptotic variance.

Hongwei Wang, Arnold Kevin Cazares*, Jasmin Ortiz*, and Abraham Guzman Vasquez Jr.*, Texas A&M International University

Statistics in Public Health [Session AIIS1]

This study examines the transparency and effectiveness of communication during the Boil Water Notice (BWN) in Laredo, Texas, and its impact on public risk perception, and compliance with protective measures. Given the role of emergency messaging in shaping public trust and financial behavior, this research seeks to assess the clarity, accessibility, and economic implications from the BWN communications. Methods: Communication effectiveness was measured using the mean value of key survey questions that assessed clarity and transparency, while risk perception was determined by evaluating respondents' sense of urgency and the precaution taken. ANCOVA was used in a survey of 1,453 residents to analyze the relationship between communication and risk perception. A multinomial logistic regression model was applied to analyze how the compliance is affected by communication, risk perception, and education levels. Result: Communication had a significant impact on risk perception (p-value¡0.001). The compliance with protective measures in the BWN in Oct 2024 compared with the compliance in the BWN before this was affected by the communication, the risk perception and the education levels. For people having the same amount of risk perception and education level, the odds of taking the

same or more precaution (instead of taking less precaution) as last BWN are higher when communication is higher. For people with a given amount of Communication and risk perception, the odds of taking the same or more precautions are also higher when the highest education level is higher compared to the lowest education level. Conclusions: The lack of clear, timely, and accessible communication during the BWN contributed to economic strain and inconsistencies in protective actions taken by the public. Statistical analysis confirms that communication effectiveness directly influenced risk perception and compliance with safety measures, with education levels further affecting behavioral response.

Maria Pieo Fernando* and S. M. Mallikarjunaiah, Texas A&M University-Corpus Christi

On a finite element approach for a spatially adaptive phase-field model for quasi-static crack propagation [Session MIS1]

In this talk, I will propose a finite element framework designed for spatially adaptive phase-field modeling to simulate the quasi-static propagation of anti-plane cracks. Traditional phase-field models work with a fixed regularization length, which can lead to either excessive computational costs or reduced accuracy. Our model employs a dynamically adaptive regularization length that adjusts based on energy minimization criteria to surpass existing limitations. The model achieves numerical stability and computational efficiency by implementing a three-field framework with finite element discretization. Adaptive mesh refinement is incorporated to optimize computational resources while preserving the accuracy of crack evolution. The model solves governing equations through iterative refinement processes specifically targeting mesh adjustments in regions with high-stress gradients and phase-field variations. The numerical results demonstrate that the method successfully tracks fracture development and improves computational efficiency. This work enhances phase-field fracture modeling by integrating adaptivity into the regularization parameter and the finite element discretization.

Kamille Garcia, Texas A&M International University

Analytical Solution of Stokes-II Problem for Kelvin-Voigt Fluid [Session MIS1]

The Kelvin-Voigt model describes the behavior of viscoelastic materials by incorporating both elastic and viscous properties. In this talk, we present preliminary results of an undergraduate research work on analytical solution for Stokes-II problem using the Kelvin-Voigt fluid model. The mathematical formulation was established based on fundamental conservation laws, leading to a system of partial differential equations. To obtain solutions for the governing equations, Laplace transform and perturbation technique were applied. Additionally, some numerical results are presented.

Saugata Ghosh*, Dambaru D Bhatta, and S. M. Mallikarjunaiah, University of Texas Rio Grande Valley

On a Computational Model to Analyze Crack-tip Fields in a Transversely Isotropic Body [Session MIIS1]

Predicting failure in materials under complex loading is crucial for reliable engineering design. This presentation introduces the Strain Limiting Model (SLM) for 2D transversely isotropic materials, a method that overcomes the limitations of traditional linear models by eliminating strain singularities. This makes SLM particularly relevant for understanding fracture in diverse materials, including composites, shale rock, and human bone. Employing the Finite Element Method, we approximate solutions to the challenging nonlinear vector-valued partial differential equations governing SLM. Our key contribution lies in directly comparing crack-tip field behavior between linearized and strain-limiting models. This comparative analysis provides critical insights into fracture mechanics, paving the way for more accurate and robust predictive failure models in engineering structures.

Mauro Guzman Jr., Texas A&M International University

Analyzing Optical Illusions Given Perception [Session AIIS5]

Optical illusions have brought attention to researchers due to the high complexity of visual perception through these illusions. However, the perception in which we distinguish optical illusions through what we can simply say neural and cognitive mechanisms, underlie their geometric properties as well as remaining elusive. Given the complexity of optical illusions, we can use computational modeling powered by high-speed computers to propose characteristics of the perception in which we distinguish and analyze the ongoings of these phenomena. By leveraging the processing power of advanced computing systems, we can simulate and analyze large-scale datasets more efficiently, facilitating deeper insights into visual perception. The model identifies key factors—such as contrast, motion, depth cues, and cognitive expectations—that influence the way illusions are perceived. The framework is intended not only to provide a clearer understanding of the mechanisms involved but also to serve as a tool for designing more effective visual displays, improving user experience in virtual environments, and advancing clinical applications in visual perception. Through empirical validation and computational simulations, we demonstrate the model's ability to predict and describe perceptual distortions across different types of optical illusions.

Ananya Gopal Hegde* and S. M. Mallikarjunaiah, Texas A&M University-Corpus Christi

An Iterative Numerical Approach for Nonlinear Wave Propagation in Elastic Bars [Session MIIS1]

This study presents a novel iterative numerical method to analyze nonlinear wave propagation in one-dimensional bars governed by algebraically nonlinear models. This approach establishes a robust computational framework that accurately captures the complexities of wave evolution, which are influenced by nonlinear elastic effects. The research derives the necessary constitutive equations and employs an iterative solution to approximate wave propagation characteristics across various boundary conditions. Numerical simulations validate the effectiveness of this method, demonstrating its versatility and stability as a preferred alternative for modeling nonlinear wave propagation in elastic materials.

Jose Herrera, Texas A&M International University

Different Treatment Drugs for Patients with Type 2 Diabetes [Session MIIS2]

In this study, we are investigating the difference between two different courses of treatment with hospitalized patients that have either Type 2 diabetes or have develop hyperglycemia. We then compare the results based on blood glucose control as well as the rate of low blood glucose between both treatments. We also consider the length of their stay in the hospital in our results to determine efficacy. The motive behind this study is due to find an alternative-like drug that will have the same effects and perhaps allow patients to maintain a higher level of glycemic control. By using the results of this clinical trial, we can use statistical analysis methods such as means/standard deviation and frequency distribution to compare the results and formulate a decision determining whether this new drug can be fully implemented. The results from this clinical trial will allow further continuation into finding more effective treatment drugs for this type of patient group.

Yejin Hwang, Texas A&M University-Corpus Christi

Stock Market Price Prediction using ARIMA, Temporal Fusion Transformer, and DeepAR [Session MIIS2]

In this research, I improve stock market price prediction by utilizing Hugging Face's implementations of Google's Temporal Fusion Transformer (TFT) and Amazon's DeepAR, alongside ARIMA. The study involves retrieving and preprocessing financial time series data from Yahoo Finance, tuning hyperparameters, and optimizing model performance. By comparing these models, I analyze their strengths and limitations in stock price forecasting.

Cesar Ovidio Ibarra, Laredo College

The Role of Programming in Applied Mathematics [Session AIIS1]

Maytee Lagunes, Texas A&M International University

Machine learning has the potential to enhance clinical decision-making by predicting cardiovascular events in patients undergoing treatment with ticagrelor [Session AIS1]

Machine learning (ML) has the potential to enhance clinical decision-making by predicting cardiovascular events, such as heart attacks, strokes, or death, in patients undergoing treatment with ticagrelor. Ticagrelor is a potent antiplatelet drug used to reduce the incidence of cardiovascular events in high-risk patients, but the response to treatment varies based on individual medical histories and other factors. This study aims to develop a predictive model using machine learning algorithms to estimate the likelihood of a decrease in cardiovascular events in 21379 patients receiving ticagrelor, based on their previous medical background. Using the National Library of Medicine (NIH) data from patient demographics, clinical history, lab results, and treatment adherence, we apply supervised learning techniques such as logistic regression, random forests, to predict the reduction in event frequency. This approach could potentially allow for personalized treatment strategies, enabling clinicians to better identify patients who would benefit most from ticagrelor therapy, while minimizing the risk of adverse outcomes. This model holds promise in improving patient outcomes through timely interventions, while offering insights into the complex interactions between medical history, treatment, and cardiovascular risk. However, model validation in clinical trials and real-world settings remains essential for confirming its reliability and generalizability.

Joshua Lopez, University of Texas at San Antonio

Assessing the Impact of Seasonality on Wolbachia-based Controls for Mosquito-Borne Diseases [Session MIS1]

Wolbachia Infection in Aedes Aegypti mosquitoes can render mosquitoes less capable of spreading mosquito-borne diseases, such as dengue and Zika. We developed and analyzed a mechanistic compartmental ordinary differential equation model to evaluate the effectiveness of Wolbachia-based vector control strategies among these wild mosquitoes in Australia, where ongoing field trials are implemented for dengue control. The model tracks the mosquito life stages, including egg, larva/pupa, and adult (male and female), and we aim to understand how seasonality affects the spread and establishment of stable Wolbachia infection among Aedes Aegypti mosquitoes. We incorporated time-varying parameters to account for the impact of seasonal climate (i.e. temperature) on mosquito life traits. These include mosquito death rates at different life stages, female reproduction rates, and development rates. Taking this into account, we identified a threshold release number of infected mosquitoes needed to establish a stable Wolbachia prevalence in the field. We further studied how the threshold may vary given seasonal variation and explored the optimal time windows for Wolbachia releases.

Hermes Luna*, Deepak Ganta, Marcus Antonius Ynalvez, and Maria Lopez, Texas A&M International University

Statistical Data Analytics and Assessment of Engineering Psychosocial Outcomes [Session MIIS2]

Interventions rely on data-driven validation to establish their effectiveness and reliability, and statistical analysis serves as the foundation for this validation. A quantitative approach not only measures impact but also strengthens the credibility of findings, transforming raw data into actionable insights. This study applies a data-driven approach to assess the effectiveness of a set of creative video project interventions among engineering students enrolled in ENGR 1201 and 1202, integrating statistical analysis through SPSS 28 and Python 3 (Jupyter Notebook 7.0.8). The set of analyses focuses on validating the intervention's impact using independent and paired samples t-tests, means and variances, and effect size (Cohen's d). Conducting independent *t*-tests allowed for comparison among control and intervention groups, while paired t-tests enabled insight into change within groups across all measurement occasions. The results varied between the full- and half-experimental designs. The full design

included M1 and M2 measurements for Cohort 1 (n=15) and Cohort 2 (n=26), while the half-design included M1, M2, and M3 for Cohort 1 (n-15) only, as Cohort 2's M3 is still in progress. Within the half design, no significant differences were found between the intervention and control groups at M1 ($p = 0.915, 0.385, 0.178, 0.530, 0.736$), indicating comparable baseline measures. Additionally, the percent change comparison from M1 to M2 among the intervention and control groups showed no significant differences ($p = 0.479, 0.828, 0.279, 0.869, 0.752$), suggesting no measurable impact after completion of ENGR 1201. However, in the full design of Cohort 1, M3 results ($p = 0.043, 0.147, 0.160, 0.224, 0.032$) indicated a significant change from M1 to M3 between groups, with the intervention group demonstrating improved psychosocial outcomes. This highlights the importance of two semesters of immersion and exposure to the CVP intervention to see effectiveness. Through a systematic application of statistical methodologies, this study highlights the applications of data analysis in evaluating intervention.

Sebastian Marcano* and Luis Molina, Lone Star Cy Fair College

Mexican American Mathematics 2025 Fall Course (Lone Star College System) [Session AIS2]

Mathematics is more than just numbers, it is the rhythm of our past, the blueprint for our future, and a universal language that transcends time and culture. It isn't meant to be easy, nor should it be. Like any meaningful pursuit, we engage with it not because it is simple, but because its challenges give it depth and purpose.

This presentation explores the development of a Mathematics for Liberal Arts course designed to align with the Mexican American Studies (MAS) degree plan, integrating mathematical concepts with cultural, historical, and social justice perspectives. The course incorporates the Mesoamerican abacus (Nepohualtzintzin) as a tool for numerical reasoning, highlights the contributions of Mesoamerican and contemporary Latinx scholars in STEM, and examines mathematical applications in public policy, economic justice, and environmental issues. By embedding ethnomathematics into the curriculum, we aim to create a more culturally relevant and accessible mathematical experience for students.

This session will share insights from the course's development, including curriculum design, interdisciplinary collaboration, and student engagement strategies. We will discuss how this initiative has connected educators and scholars nationwide, fostering a growing movement to redefine mathematics education through cultural inclusion. Ultimately, our work demonstrates the power of mathematics as a tool for critical thinking, advocacy, and community empowerment, reinforcing its relevance beyond the classroom.

Ashley Marines, Texas A&M University-Corpus Christi

Bridging Attention and Convolution: A Knowledge Distillation Framework for Object Detection [Session MIIS2]

High-accuracy object detection remains a critical challenge in computer vision, particularly in complex and diverse environments. This study proposes a novel object detection system that synergizes Region-based Convolutional Neural Networks (R-CNN) with Transformer architectures to improve precision and recall in identifying and localizing objects within the Common Objects in Context (COCO) 2017 dataset. By leveraging a knowledge distillation framework, a Vision Transformer (ViT) acts as a high-capacity teacher model, guiding a more lightweight Faster R-CNN student model to achieve both performance efficiency and deployment feasibility.

The COCO dataset, with over 200,000 images and 1.5 million object instances across 80 categories, provides a rigorous benchmark for evaluating the model's effectiveness. Our architecture capitalizes on the self-attention mechanisms of Transformers to enhance global feature representations while preserving the computational efficiency of convolutional approaches. The knowledge distillation process aligns feature maps and classification logits between the teacher and student models, employing a dual loss function to ensure robust feature transfer.

Experimental results demonstrate that the hybrid model surpasses traditional object detection architectures in terms of mean Average Precision (mAP) across multiple intersection-over-union (IoU) thresholds. Additionally, the introduced an anomaly scoring mechanism to detect out-of-distribution objects, extending the model's applicability to anomaly detection tasks. The approach highlights the benefits of combining attention-based and convolutional mechanisms, paving the way for more efficient and accurate object detection systems in real-world scenarios.

Jesus A. Mendiola Herrera, Texas A&M International University

A preliminary study of Hilbert-Kunz functions: co-

efficient behavior in a normal affine semigroup ring [Session MIIS1]

In 1890, David Hilbert published an article on what now constitutes one of the bases of commutative algebra; his work would eventually influence the efforts of mathematicians like Pierre Samuel, D.G. Northcott, and Ernst Kunz. In 1969, Ernst Kunz introduced a particular mapping regarding modules of regular local rings. His goal was to characterize regular Noetherian local rings of prime characteristic by computing the length of the module with respect to its maximal ideal under Frobenius power transformations. In this presentation, the focus will be on stating the initial steps on investigating the coefficients of the Hilbert-Kunz function of the normal affine semigroup ring of the form $R = k[u, su, s^2u, ..., s^au, lu, slu, s^2lu, ..., s^bl^hu]$ which is associated with the affine semigroup ring generated by $A(0, 0, 1)$, $B(a, 0, 1)$, $C(b, h, 1)$, and $D(0, h, 1)$ in $\mathbb{Z}^3$. The Hilbert-Kunz function will determine the length of the module of such Noetherian ring when under Frobenious power transformations. Finding such length can offer geometric properties and growth insights of the ring.

Carlos Elias Montemayor Tristan, Texas A&M International University

Techniques to Tutor Math to College Students [Session AIS2]

Tutoring math to college students requires a strategic approach to address individual learning needs and promote academic success. This abstract outlines effective techniques for tutoring math to college students, emphasizing the importance of personalized instruction and interactive learning methods.

Key Idea: The key idea is to provide a supportive and interactive learning environment that fosters student engagement, builds confidence, and promotes mastery of mathematical concepts. By acknowledging individual learning styles and difficulties, tutors can tailor their instruction to meet the unique needs of each student.

Methods: Effective techniques for tutoring math to college students include:

1. Personalized instruction: Tailoring instruction to meet individual learning needs and abilities.

2. Interactive learning methods: Utilizing visual aids, technology, and collaborative learning activities to engage students and promote understanding.

3. Problem-solving strategies: Teaching students to approach problems in a logical and methodical way, using techniques such as drawing diagrams and checking solutions.

4. Formative assessments: Regularly assessing student understanding and adjusting instruction accordingly.

Conclusion: By incorporating these techniques into math tutoring, educators can create a supportive and interactive learning environment that promotes academic success and fosters a deeper understanding of mathematical concepts. By tailoring instruction to meet individual needs and abilities, tutors can empower college students to overcome math anxiety and achieve their academic goals.

Rebecca Aishwarya Namala* and S. M. Mallikarjunaiah, Texas A&M University-Corpus Christi

A Spatiotemporal Approach for Real-time Video Anomaly Detection [Session AIS1]

The surveillance systems have increased in every city, resulting in increased video data, which needs to be processed to detect activity in the video. Manual review is labor-intensive, and basic machine learning methods fail to identify anomalies in the video accurately. This project introduces CrimeScope, a spatio-temporal convolutional Network (STCN) that leverages 3D convolutional layers to extract both spatial and temporal features and incorporates attention mechanisms to highlight subtle, dynamic irregularities indicative of anomaly such as criminal activity. Experiments on UCF Large Crime Dataset from Kaggle demonstrate that CrimeScope outperforms a baseline autoencoder model, achieving over 95% accuracy along with significant gains in precision and recall. These results underscore CrimeScope's potential to enhance automated surveillance systems by providing a scalable and efficient solution for real-time anomaly detection in urban environments.

Juan Carlos Nava, Texas A&M International University

Applications of the Mathieu Groups in Error Correction and DNA Sequencing [Session AIIS5]

A foundational idea in mathematics lies in breaking down existing components into their bare fundamentals. As evidenced by prime numbers and composites, we learn this idea at an early age. Categorizing these broken down components into their simplest form allows mathematicians to construct proofs from emergent patterns. Furthermore, the mathematics of information theory allows

us to transmit information with precision and certainty.

John Conway's Atlas of Finite Groups in the 1990's was particularly concerned with the categorization of structures known as groups. There are certain axioms a group must adhere to, which amount to the retention of symmetry; ultimately a group helps us to better understand symmetric actions performed on a set with a binary operation. The Classification of Finite Simple Groups states that a finite group, that is, a binary operation coupled with a set, which contains a finite amount of symmetries, will break down into a simpler group; these are known as follows: cyclic groups, alternating groups, groups of Lie type, or a sporadic group (of which there are 26 varieties). This classification of finite groups breaking down into simple finite groups is considered a milestone in modern mathematics. The goal of this research is to examine the finite simple groups in depth, and search for applications of sporadic groups.

By utilizing existing applications that tie together information theory and group theory, we aim to discover more unique versions of the aforementioned generators and subgroups, we will yield applications for sporadic groups, in particular Mathieu Group (M_{11}) in other fields of mathematics and sciences. A common application for the Mathieu Groups is in error correction, a field of information theory that allows data to be transmitted with self-correcting algorithms that can compensate for noise in a system.

Deoxyribonucleic acid (DNA) sequencing is one potential application for the use of these sporadic groups, and there exists literature that details the manners in which a sequence of DNA nucleotides may serve as a generator of a group. Seeing as the most successful application that exists for Mathieu Groups is error correction in signal analysis, the goal is to discover if a similar approach might allow for error correction in DNA mutations. It is assumed that by treating a string of DNA as a codeword, we may be able to apply error correcting algorithms to preserve intended sequences of DNA and prevent harmful mutations, or perhaps reveal if DNA already comes with an error-correcting mechanism. Two such error-correcting mechanisms, the Hamming and Golay Linear Codes, are of particular interest to the research because of how they utilize the Mathieu Groups. A set of codewords that form a vector subspace of a finite vector space over a finite field is called a linear code; treating DNA as such is one assumption made in the research. The study of certain open problems in mathematics allows us to sometimes put to the test existing theorems and discover new applications. It is our aim that we may discover a sequence or group isomorphism that can emulate DNA sequencing.

Ultimately, the goal is to apply error-correction mechanisms (such as Golay Codes) to linearly coded DNA and determine if DNA may preserve its structure, which can yield further applications and allow medical technology to flourish.

Rasheedat Oladoja, Texas Tech University

A Novel Approach to Count Data Modeling: The Complex Tri-Parametric Pearson Distribution and Its Applications [Session AIS1]

Count regression models are widely applied in scientific research to analyze discrete data, yet traditional methods, such as Poisson and Negative Binomial regressions, often struggle with over-dispersion, under-dispersion, or zero inflation. This study introduces the Complex Tri-Parametric Pearson (CTP) distribution, an extension of Pearson's family of discrete distributions, offering a more flexible alternative. We examine its theoretical properties, derive parameter estimates via Maximum Likelihood Estimation (MLE), and evaluate its performance across real-world datasets. Empirical results demonstrate that the CTP model consistently outperforms conventional approaches in capturing dispersion characteristics and improving model fit, making it a valuable tool for count data analysis.

Arianna Ortiz, Texas A&M International University

The Health Benefits of Physical Activity [Session AIS1]

This review intends to assess the effects of consistent physical activity on health outcomes through a comparison between regular exercisers and non-active persons. Based on statistical approaches applied in clinical trials, such as cohort analysis, regression models, and hypothesis testing, the major health advantages of physical activity are underlined. These advantages consist in higher mental well-being, enhanced metabolic activity, improved cardiovascular health, and lower risk of chronic diseases. The data offered comes from observational research showing a clear link between consistent exercise and good health outcomes, as well as from randomized controlled trials. The statistical tools applied to examine these impacts concentrate on how they enable to measure the influence of exercise on long-term health. By emphasizing the im-

portance of merging physical activity into daily life, the presentation highlights the value of exercise as a preventive and therapeutic measure in clinical settings.

Hugo Rodriguez, Texas A&M International University

Home Match [Session AIIS5]

Demographic data was collected from the home buyers at Winfield Communities as of November 22, 2024. The sample size is of 20 homes. The data collected from the customers includes the age of the customer, or the average age for the homes purchased by a couple. The customers were asked for their line of work. Additionally, the customers were asked for the number of dependents of any age. For the last parameter, in place of having the customers provide their pre-approval letter, the final sales price was provided by the home builder. The dependent variables for the study were collected from the design and purchasing teams at Winfield Communities. These variables include: the size of the lot purchased, the number of bedrooms, the number of bathrooms, and the garage size of the home. Additionally, the amount spent on upgrades was considered as a separate variable from the sales price. Finally, the model from the home builder's product line as considered in addition to the bedroom, bathroom, and garage size along with the style of the home purchased.

Ricardo Saenz, Laredo College

Anomaly Detection, why it's important and how it's done [Session AIIS1]

Data is a vital part of everything in modern society. We use it to identify trends, monitor progress, and make educated guesses at the future. The way we interpret data dictates many of the decisions made in government, industry, or the choices we make as individuals. It is the fundamental foundation of any reasonable decision. Which is why it is paramount for our gathered data to be accurate and reliable, but sometimes it isn't. Occasionally there are outliers in our data, random deviations often called a "Statistical anomaly". These anomalies can vary greatly in magnitude and depend heavily on the data gathered, and the method used to gather it. But often they are ignored for their relative infrequency. However, the examination and exploration of seemingly insignificant variations in data have many times opened entirely new avenues of understanding. Which introduces the purpose of this presentation, anomaly detection. How it is done, and how sometimes choosing to closely examine a seemingly insignificant phenomenon has brought new waves of information and has moved industries with it.

Maria Fernanda Vasquez*, Hongwei Wang, Deepak Ganta, and Khaled Enab, Texas A&M International University

The Impact of Visualization and Gamification in Engineering and Statistics Classes in College [Session AIIS4]

This study, sponsored by the National Science Foundation (NSF), examines the impact of visualization and gamification on student engagement and learning outcomes in college-level Statistics courses (Engineering Statistics and Statistical Analysis). The research involves a control group of 15 students and an intervention group of 13 students, with the latter receiving instruction through gamification techniques. Visualization, including interactive graphs and real-time simulations, helps students engage more effectively with abstract concepts, while gamification, incorporating elements like points, badges, and leaderboards, boosts motivation and participation. At the end of the semester, students in the intervention group presented their work, showcasing how they competed as a group, further highlighting their collaborative effort and deep engagement with the material. Survey results indicate that students in the intervention group felt significantly more motivated to work hard compared to those in the control group. Statistical analysis shows that a student in the intervention group was 67% more likely to obtain an A (90 or higher) in the course than a student in the control group. Furthermore, performance data at the end of the semester revealed that the intervention group achieved higher overall grades. By conducting a t-test, through Python on Google Colab, on the final course grades we can conclude that the intervention had a significant impact on student success (p-value = 0.0416). These findings highlight the positive impact of visualization and gamification on both student moti-

vation and academic performance. The study suggests that integrating these methods into STEM curricula can enhance learning outcomes and provide students with a more engaging, effective educational experience.

Bryan Villagomez, Laredo Community College

Our responsibility to Taxes [Session AIS2]

Apart from finance the basic services are education, health care, roads and police. There are many different ways of paying taxes; these include income tax, sales tax, property tax and corporate tax. Each has its own role in sharing the financial burden between individuals and businesses. However, while the necessity for taxes are often seen it is also frequently hated. Whenever the rates look high or people feel that they have been cheated by a law which could never work, this attitude will crop up. In principle, a good tax system ought to be fair. People with more money should contribute more; yet at the same time it should enable economic growth and personal stability. But sometimes it does not work out as planned.Subsequent tax evasion, loopholes and complex legislation have occurred inequalities appeared, necessitating a re-examination. In an ideally balanced tax structure the financial needs of many can be met efficiently, while people are still free to pursue their own fortunes or go into business for themselves. In the final analysis, taxes are this shared investment in the society's future. They may not be loved but they are needed to build into existence a better world.

Joel Williams* and Mike Lindstrom, University of Texas Rio Grande Valley

Mathematical Modeling of Neurodegenerative Prion Diseases in One-Dimensional Neuronal Networks [Session MIIS1]

This presentation introduces a mathematical model to simulate the progression of prion diseases in the brain. We model neurons as they interact with normal and misfolded (scrapie) proteins. The model uses a delay differential equation to describe changes in protein concentrations and neuronal viability, using various parameters to regulate protein degradation, misfolding rates, and the spread between interconnected neurons. Neurons are modeled in a one-dimensional space with various connectivity distributions to mimic different types of neuronal networks. We visualize how neurodegenerative diseases propagate through the neuronal network over time and even account for how different brain regions permit their spread.

3.3 Student Presentations (Class Topics)

David Cepeda, Texas A&M International University

The complex variable of graphic design [Session AIIS2]

Since the introduction of Adobe Illustrator in 1987, graphic design has significantly evolved from traditional pen-and-paper methods to sophisticated vector-based graphics. Central to this transition is the use of complex variables, which allow designers to create infinitely scalable, high-resolution images. This paper explores how complex variables, specifically complex numbers and operations within the real and imaginary plane, serve as the backbone of essential graphic design tools. By examining methods such as rotating shapes using Euler's formula and manipulating vector graphics through complex transformations, we uncover the mathematical foundations behind modern graphic design software. Additionally, the paper documents the creation of a new software, which integrates these complex variable techniques, providing practical demonstrations and insights into the intersection of mathematics and visual creativity.

Jazlyn K. Gomez, Texas A&M International University

Pretty Pictures with Complex Variables [Session AIIS2]

Complex variables can provide a visual way to understand mathematical structures. With computing skills, we can show how complex variables can be used to paint a visually appealing picture. For example, the Julia Set.

Maytee Lagunes, Texas A&M International University

Prime and Composite Numbers [Session AIIS2]

Prime and composite numbers are fundamental concepts in number theory, with profound implications in mathematics and its applications. The study of prime numbers has led to numerous discoveries, including the development of algorithms used in cryptography, while composite numbers are central to the understanding of factorization. The distinction between primes and composites is crucial for topics such as divisibility, prime factorization, and the fundamental theorem of arithmetic, which asserts that every integer greater than 1 is either prime or can be uniquely expressed as a product of prime numbers. Exploring the properties, distribution, and applications of these numbers continues to be a rich area of mathematical research.

Jesus Pachicano, Texas A&M International University

Schwarz-Christoffel Mappings on Irregular Domains: Fractal Conformal Geometry [Session AIIS3]

The Schwarz-Christoffel Transformation is an important fundamental tool in complex analysis that provides explicit formulas mapping the upper half-plane of the complex plane to a finitely segmented polygonal domain. This paper will explore the history and provide a detailed background of Schwarz-Christoffel Transformations. I will generalize this tool to fractal geometries, focusing on the Mandelbrot set, where fractal geometries are defined by their infinite line segments. By generalizing this transformation tool to fractal geometries, I aim to highlight the connection between complex analysis and applied mathematics in fluid dynamics and computer graphics: the theoretical and real-world computational applications.

Adriana Perez, Texas A&M International University

Complex Matrices [Session AIIS3]

Complex matrices are the implantation of complex numbers, the set is denoted as C^n, and organized as a double array entry from each polynomial equation coefficient, known as a matrix. In most cases, real and complex numbers have the same operations; however, real solutions will not include an imaginary component whereas complex solutions will. Thus, it can be solved by operations (addition, subtraction, etc.) and properties (Hermitian and unitary matrices) which allow professionals to visualize and read the data they are unable to see with the naked eye such as wave behavior, circuit flow and manipulate data for efficient flow throughout a circuit.

Daniela Sandoval, Texas A&M International University

Branch Cuts in Complex Analysis [Session AIIS3]

In complex analysis, branch cuts are strategically placed line segments or curves that transform multivalued functions into single-valued ones by selecting a consistent branch for each point in the domain. Functions such as the logarithm and square root naturally exhibit multivalued behavior, necessitating the introduction of branch cuts to eliminate ambiguity. These cuts originate from branch points, where the function transitions between multiple values, and extend to another branch point or infinity, preventing paths from encircling the singularity and yielding inconsistent values. However, this process introduces a discontinuity along the cut, trading smoothness for single-valuedness. An alternative approach using Riemann surfaces preserves continuity by layering multiple sheets of the complex plane, seamlessly transitioning between branches. Theoretical tools such as the Riemann Mapping Theorem and Monodromy Theorem provide further insight into the structure and behavior of branch cuts. Beyond pure mathematics, branch cuts have practical applications in fields like electrical engineering, where they aid in the analysis of signal phase and system stability. Ultimately, the study of branch cuts integrates techniques from topology, differential geometry, and analytic continuation, offering a fundamental method for managing multivalued functions in complex analysis.

Leonardo San Miguel, Texas A&M International University

Riemann Sphere [Session AIIS4]

Understanding the Riemann Sphere and its applications.

Roxana Zamora, Texas A&M International University

Cauchy's Integral Formula vs Cauchy's Residue Formula [Session AIIS4]

Cauchy's Integral formula and Cauchy's Residue formula are fundamental formulas used in complex analysis. In Cauchy's Integral formula, a function must be holomorphic in a simple closed curve to allow the function to be evaluated at any point inside the curve by using an integral over the boundary of the curve. Cauchy's Integral formula leads to the derivation of Taylor and Laurent series and solving complex integrals. Cauchy's Residue formula applies to contour integrals with isolated singularities, or meromorphic functions. A singularity, also referred to as a pole, are isolated points where the function is unbounded. A residue is the coefficient of the $(z-a)^{-1}$ in the Laurent series around the pole. The contour integral is equal to the sum of the residues multiplied by $2\pi i$. Cauchy's Residue formula is used for solving improper integrals, definite integrals, and differential equations.

3.4 Poster Presentations

Roberto Arias*, Kristina Vatcheva, Vesselin Vatchev, Jesus Melgarejo, and Gladys Maestre, University of Texas Rio Grande Valley

Novel Feature Extraction from Ambulatory Blood Pressure Data [Session MIIP]

Ambulatory blood pressure monitoring (ABPM) provides blood pressure (BP) measurements over a 24-hour period. This method identifies abnormalities in BP that are often undetected using conventional methods such as office BP readings. Although measures derived from ABPM improve management of hypertension and stratification of cardiovascular diseases, current metrics fail to fully capture the complex, nonlinear, and non-stationary dynamics of BP behaviors. This study aims at examining 24-hour ABPM data to extract novel features that better describe the complexity of a dynamic cardiovascular system. By conducting a multi-resolution analysis (MRA) with the maximal overlap discrete wavelet transform (MODWT) on interpolated ABPM data, BP time series are decomposed into multiple resolution levels, revealing patterns across various temporal scales. recurrence quantification analysis (RQA) metrics such as recurrence rate, determinism, and laminarity are extracted from each decomposed level to capture dynamic, nonlinear BP variability and behavior. Additionally, derivatives analysis on interpolated data is conducted to identify abrupt surges or dips, emphasizing transient dynamics. To demonstrate the clinical relevance of these novel features, they will be integrated into machine learning frameworks along with mixed effects modeling to assess their ability to predict adverse health outcomes. This innovative approach provides time-localized scale-specific insights into BP regulation, addressing limitations of traditional methods and enabling more refined clinical assessments. The methodology demonstrates significant potential for enhancing BP interpretation and offering a transformative perspective on variability.

Donaldo Davila, Max Lopez, and Juan Bernal*, Laredo College

The Center of Mass: A Key to Stable Structures in Engineering [Session MIIP]

The center of mass is an important idea in civil engineering and math. It is the point where an object's weight is balanced. Engineers use this concept to design safe buildings, bridges, and other structures. For example, tall buildings are designed with a stable center of mass so they can stand strong against wind and earthquakes. Bridges also need a well-planned center of mass to carry heavy loads without becoming unstable. Roads and dams also rely on this concept to distribute weight evenly and prevent structural failures.

In math, the center of mass helps students understand how numbers and shapes apply to real life. It uses ideas from algebra and geometry to solve problems. By learning how to calculate the center of mass, students can see how math is connected to construction and engineering. This concept is important for future engineers because it helps them design structures that are safe and efficient.

This presentation will simply explain the center of mass, showing why it matters in civil engineering and how it is used in real world construction and design.

Andres Cabello* and Gerardo Guerrero*, Laredo College

Battery Discharge Rate Across Common Brands [Session MIIP]

Given the rise of lithium-based rechargeable batteries in the last decade across consumer electronics, the reliance on alkaline batteries has decreased. This decreased dependency on alkaline batteries ultimately results in consumers' decreased trust when purchasing disposable batteries. Yet, there is still a continued demand for small consumer electronics powered by AA's, thus prioritizing a quality product for consumers to purchase. The course of this research aims to study the discharge rate of AA alkaline batteries over time. The pool of brands used in this experiment will stem from commonly acquired brands such as Duracell, Rayovac, Energizer, and more. A single discharge device will be utilized to simulate a power draw across each battery, and the results will be averaged across each brand and tabulated. To conclude, the information gathered from the experimentation will provide comprehensive insight into the durability and wear-usage of the selected batteries and determine which would be recommended for use.

Jorge Alejandro Cuevas, Laredo College

Financial Literacy - Budgeting with Math [Session MIIP]

Financial literacy is a crucial life skill that empowers individuals to make informed financial decisions, avoid debt, and achieve long-term stability. This presentation focuses on the fundamentals of budgeting using math, helping students understand how to allocate their income effectively using percentages and proportions. Key topics include the breakdown of essential expenses such as housing, transportation, savings, and discretionary spending, demonstrating how small financial adjustments can lead to significant long-term benefits. Additionally, the presentation covers the mathematical principles behind interest rates, loans, and credit cards, highlighting how compound interest can either grow savings or accumulate debt. By applying simple formulas and real-life scenarios, students will learn how to calculate interest, understand the impact of minimum payments, and make smart credit decisions. The goal is to equip students with practical tools to manage their finances wisely, avoid common financial pitfalls, and develop strong money management habits. Through this presentation, students will gain a clear understanding of how math plays a vital role in financial success and how they can take control of their financial future.

Zhuolin Qu and Lauren Estrada*, University of Texas at San Antonio

Modeling the Interplay of Human Behaviors and Mosquito-Borne Diseases through Behavior-driven Socio-biological Framework [Session MIIP]

Mosquito-borne diseases remain a persistent public health challenge. While mathematical models aid in disease prevention and control, most focus mainly on biological and environmental factors, often overlooking crucial social dimensions. This gap stems from the lack of methods to quantify the human behavioral impact on human-mosquito contacts, which is central to disease spread.

To bridge these gaps, we develop a behavior-driven socio-biological framework that integrates mathematical, biological, and social sciences. Specifically, we extend the traditional SEIR-SEI human-vector disease transmission model by incorporating the Transtheoretical Model of Behavior Change from social science and capture how individuals transition through five behavioral stages: Pre-informed, Informed, Prepared, High Action, and Low action. This behavioral model is linked to the disease transmission model by people's perceived amount of risk, which alters people's adoption of protective behavior. The behavioral changes, in turn, feedback into the disease model by reducing human-mosquito contact rate or mitigating mosquito abundance.

By explicitly modeling human decision-making into epidemiological modeling, our approach offers a more comprehensive understanding of disease transmission and informs potential intervention strategies for mosquito-borne diseases.

Isaac Garay, Texas A&M International University

Fourier Transformations and its relationship to MRI [Session MIIP]

Fourier Transformations play a crucial role in Magnetic Resonance Imaging (MRI) by converting raw signal data into detailed images. This presentation explores the mathematical foundation of Fourier Transformations and their application in MRI, highlighting their importance

in medical imaging and diagnostics.

Osvaldo Garza, Laredo College

Error Detection and Correction in Cybersecurity [Session MIIP]

Error detection and correction play a key role in keeping our digital world secure. As we send data across networks or store it in systems, errors can creep in due to things like network issues, hardware failures, or even cyberattacks. To catch these mistakes, methods like checksums, parity bits, and hashing algorithms are used to spot any discrepancies in the data. Once an error is found, correction techniques, like forward error correction or requesting data to be resent, help fix it. These processes are vital for ensuring that data remains accurate and safe, especially in cryptographic systems, secure communications, and data storage. As cyber threats continue to evolve, improving error detection and correction methods is more important than ever to protect our digital systems from potential breaches and keep our information safe. By continuously advancing these techniques, we can enhance the overall security and reliability of digital infrastructure, making it more resilient against emerging threats and reducing the risk of data corruption or loss.

Edward Gomez Jr., Laredo College

The Differences in the way drones are operated based on size [Session MIIP]

Drones vary significantly in operation based on their size, influencing their control, usage, and technology. Small drones, often referred to as micro or mini drones, are typically lightweight, easy to maneuver, and ideal for recreational use or simple tasks like photography and surveying. These drones typically have a shorter flight time compared to other bigger drones. Including the fact that there is no need for training. In contrast bigger drones or drones used for military use require a significant finesse to operate these machines. People are required to take specific training learning how to control the drone and safety protocols. Bigger drones are able to fly for significantly longer time than smaller drones while also overcoming difficult environments. These drones and also usually fixed with a GPS and more complex systems so that they are able to pick up more information. As you can see there are many differences in these drones. In this presentation the significance of these drones will be explored more in depth.

Jeffery Opoku, University of Texas Rio Grande Valley

Ramanujan-Fine integrals for level 10 [Session MIIP]

We investigate the question of when an eta quotient is a derivative of a formal power series with integer coefficients and present an analysis in the case of level 10. As a consequence, we establish and classify an infinite number of integral evaluations such as

$$\int_0^{e^{-2\pi/\sqrt{10}}} q \prod_{j=1}^{\infty} \frac{(1-q^j)^3(1-q^{10j})^8}{(1-q^{5j})^7} dq$$

$$= \frac{1}{4}\left(\sqrt{10-4\sqrt{5}}-1\right).$$

We describe how the results were found and give reasons for why it is reasonable to conjecture that the list is complete for level 10.

Ben-Oni Spradlin, University of Texas Rio Grande Valley

A Mathematical Model of Alzheimer's diseases [Session MIIP]

The peptide Amyloid Beta ($A\beta$) 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 of particular interest due to them exhibiting varying degrees of toxicity. Factors such as production, clearance, transport, internalization, externalization, and aggregation can lead to changes in concentrations of these species which affecting neuronal health in different regions of the brain. And each different region has a unique neuronal composition. In this poster, we present a mathematical model focused upon differential susceptibility and key $A\beta$ species to describe Alzheimer's progression. Model parameters are informed by published literature of $A\beta$ kinetics, cell viability assays, and other experiments. We will focus upon the hippocampus, cerebral cortex, and cerebellum, finding various levels of accordance between our model and clinical outcomes. We also quantify the

relative influence of different biological parameters in predicting the course of disease.

Samiha Zakir* and Kristina Vatcheva, University of Texas Rio Grande Valley

Joint Modelling of Longitudinal Estimated Glomerular Filtration Rate and Time to Acute Kidney Injury [`Session MIIP`]

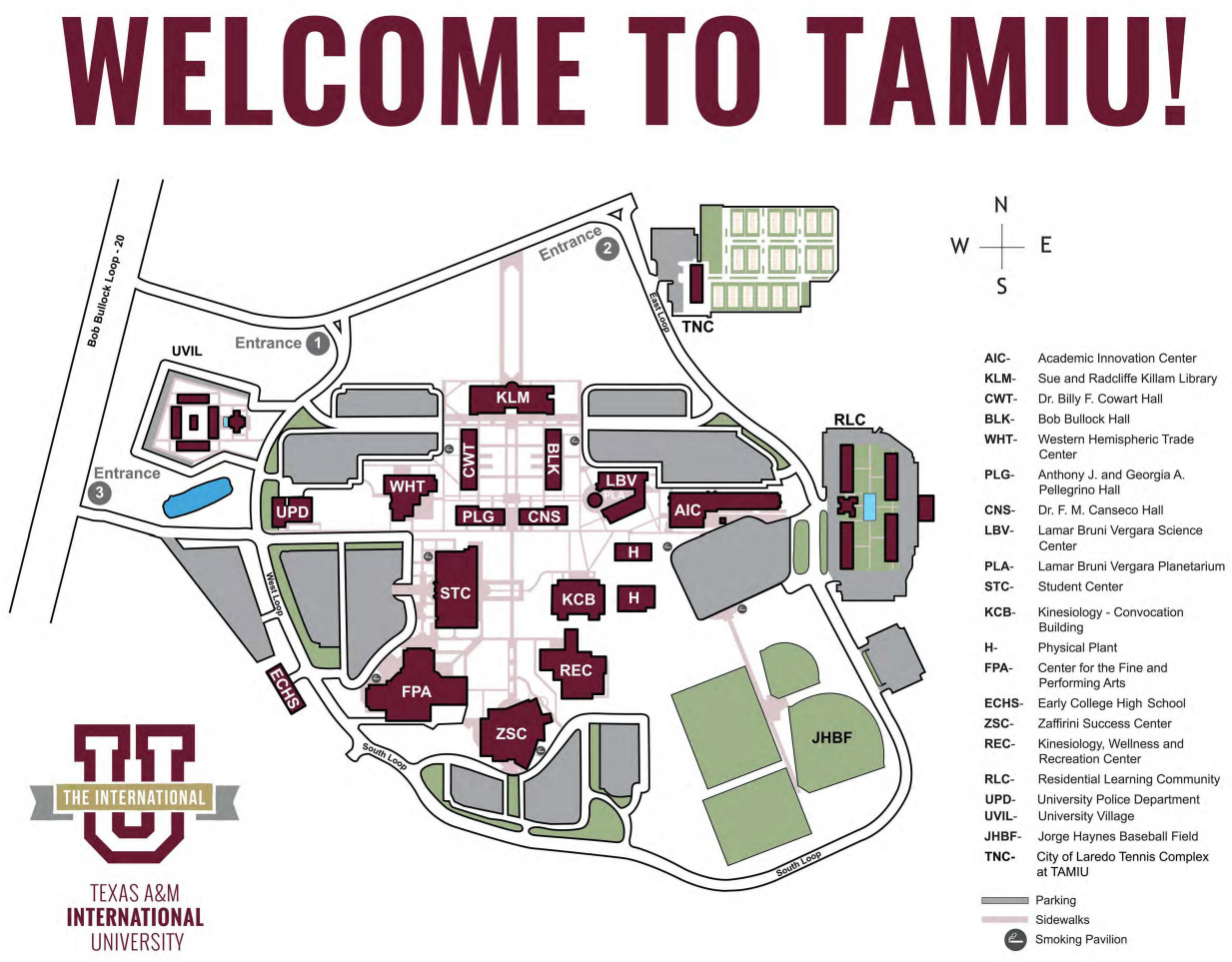
Research has shown that progressive declines in estimated glomerular filtration rate (eGFR) precede Acute kidney injury (AKI), but the relationship between longitudinal eGFR trends and AKI risk remains underexplored. This study investigated the phases of eGFR decline and assessed their association with the risk of AKI.

Our data consists of follow-ups observations from 459 lung transplant patients tracked over 7 years ($n = 6419$). We used a piecewise linear mixed-effects model to analyze longitudinal eGFR changes, while a Cox proportional hazards model evaluated AKI risk. We integrated a joint model to assess the interplay between eGFR trajectories and AKI outcomes. Covariates included gender, pre-transplant eGFR, age at transplantation, and antibody-mediated rejection (AMR).

In longitudinal model, Male recipients had a higher baseline eGFR ($+5.78$ mL/min/1.73 m^2, $p = 0.0002$), while older age at transplantation was associated with a more significant decline (-0.56 mL/min/1.73 m^2 per year, $p < 0.0001$). The Cox proportional hazards model showed that pre-transplant eGFR was protective against AKI (HR $= 1.006$, 95% CI: $1.002 - 1.010$, $p = 0.0028$), while AMR increased the risk (HR $= 0.327$, 95% CI: $0.142 - 0.752$, $p = 0.0085$). The joint model revealed gender-specific differences, with males having a higher AKI risk (HR $= 1.15$, $p < 0.0001$). The joint model provided deeper insights compared to individual models. While individual models identified key phases of eGFR decline and risk factors for AKI, the joint model revealed how these processes interact, including gender-specific risks and the mediating role of pre-transplant eGFR. These findings emphasize the importance of early monitoring and tailored interventions to mitigate AKI risk and improve post-transplant outcomes.

4 Logistic Information

4.1 University Map



4.2 Internet Access Information

Internet access account information is available at registration desk.

4.3 Travel Information and Directions

The address of Texas A&M International University is: 5201 University Blvd, Laredo, Texas 78041.

The twin cities of Laredo, Texas and Nuevo Laredo, Mexico, which celebrated their 250th anniversary in 2005, are situated on the banks of the Rio Grande. Laredo, which has a population of 257,600, has been governed under seven national flags. Nuevo Laredo has a burgeoning population of 373,700. The twin cities are collectively referred to as Los Dos Laredos. The weather is moderate in winter months around 68°F (20°C) but sizzling in mid-summer around 100°F (39°C).

This city is the commercial hub of the South Texas Plains, which is primarily an agricultural region. It offers entertainment, education, and cultural resources that fit well with its Hispanic heritage. Laredo is one of the fastest growing cities in the United States.

Laredo is accessible by car via Interstate 35, and US Highways 59 and 83. Laredo International Airport (IATA: LRD) (ICAO: KLRD), has scheduled direct flights to Dallas/Fort Worth (80 minutes), Houston (80 minutes), and Las Vegas (165 minutes) via American Eagle, Continental Express, and Allegiant Air.

Important: Non-US citizens are required to carry immigration/traveling documents (such as a visa, passport, and/or Green Card) with them even if they do not plan on crossing the border into Neuvo Laredo, Mexico. There are immigration checkpoints on highways and at the airport of Laredo, where the U.S. Border Patrol will conduct checks to verify immigration status. US citizens are recommended to carry their passport with them.

Parking on campus is free except reserved parking lots. Additional parking information can be secured from `http://www.tamiu.edu/adminis/police/trfrgs.shtml`.

4.4 Local Attractions

Historic attractions in old Laredo include Plaza San Augustin (where various dance, music and crafts festivals take place throughout the year), the Republic of the Rio Grande Museum, and El Mercado, the old city hall.

Wildlife game abound in south Texas, so Laredo is a popular destination for hunters and fishermen. Birders can spot the Great Kiskadee, White-tipped Dove, Green Jay, Scrub Jay, Red-billed Pigeon, Audubon's Oriole and possibly the White-Collared Seedeater in the region.

4.5 Lodging

Each 2025 CBMSC attendee shall make their own reservation. Limited rooms of the following hotels have been reserved for the 2025 CBMSC with special rates.

- Tru by Hilton Laredo Airport
  7120 Rosson Lane, Laredo, TX 78041, 956-615-1675
  Block Dates: April 4, 2025 - April 6, 2025 (Cut-off Date for Reservations: March 30, 2025)
  Booking Code: CBMSC
  https://group.trubyhilton.com/7yl8ci

- La Quinta Inn & Suites by Wyndham Laredo Airport
  7220 Bob Bullock Loop, Laredo, TX 78041, 956-724-7222
  https://www.wyndhamhotels.com/laquinta

There are other choices of hotels in Laredo, Texas.

Name	Phone	Address
Holiday Inn Express	(956)218-8888	7223 Bob Bullock Loop
Staybridge Suites	(956)724-7222	7010 Bob Bullock Loop
Best Western San Isidro Inn	(956)723-1600	1410 Hospitality Dr
Amerik Suites	(956)725-5222	6551 Metro Ct
Homewood Suites by Marriott	(956)753-9200	98 Calle Del Norte
Hampton Inn	(956)717-8888	7903 San Dario
Residence Inn by Marriott	(956)753-9700	310 Lost Oak Blvd
Days Inn	(956)724-8221	7060 San Bernardo Ave
Fairfield Inn & Suites	(956)722-4533	700 W Hillside Rd
Red Roof Inn	(956)712-0733	1006 W Calton Rd

4.6 Local Organizers Contact Information

The 9th Coastal Bend Mathematics and Statistics Conference Organizing Committee consists of:

- Rohitha Goonatilake, harag@tamiu.edu (Chair)
- Juan J. Arellano Jr., juan.arellano@tamiu.edu
- Mahanthesh Basavarajappa, mbasavarajappa@tamiu.edu
- Cesar Contreras, cesar.contreras1@tamiu.edu
- Saqib Hussain, saqib.hussain@tamiu.edu
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- Jose Rico, jose.rico@tamiu.edu
- Norma Saikali, norma.saikali@tamiu.edu
- Rolando Peña Sanchez, rsanchez@tamiu.edu
- Hongwei Wang, hongwei.wang@tamiu.edu

4.7 Photographer

Mr. Charles A Whitfield will be the official photographer of the conference.

Acknowledgement

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The 9th Coastal Bend Mathematics and Statistics Conference is also supported by the Department of Mathematics and Physics, the Graduate School, the Office of Admission, the Office of Community Relations and Special Events, the Office of Information Technology, the Office of Outreach and Precollege Programs, the Office of the Provost and Vice President for Academic Affairs, the Office of Recruitment and School Relations, the Office of the Vice President for Institutional Advancement, and the University Police Department of TAMIU.