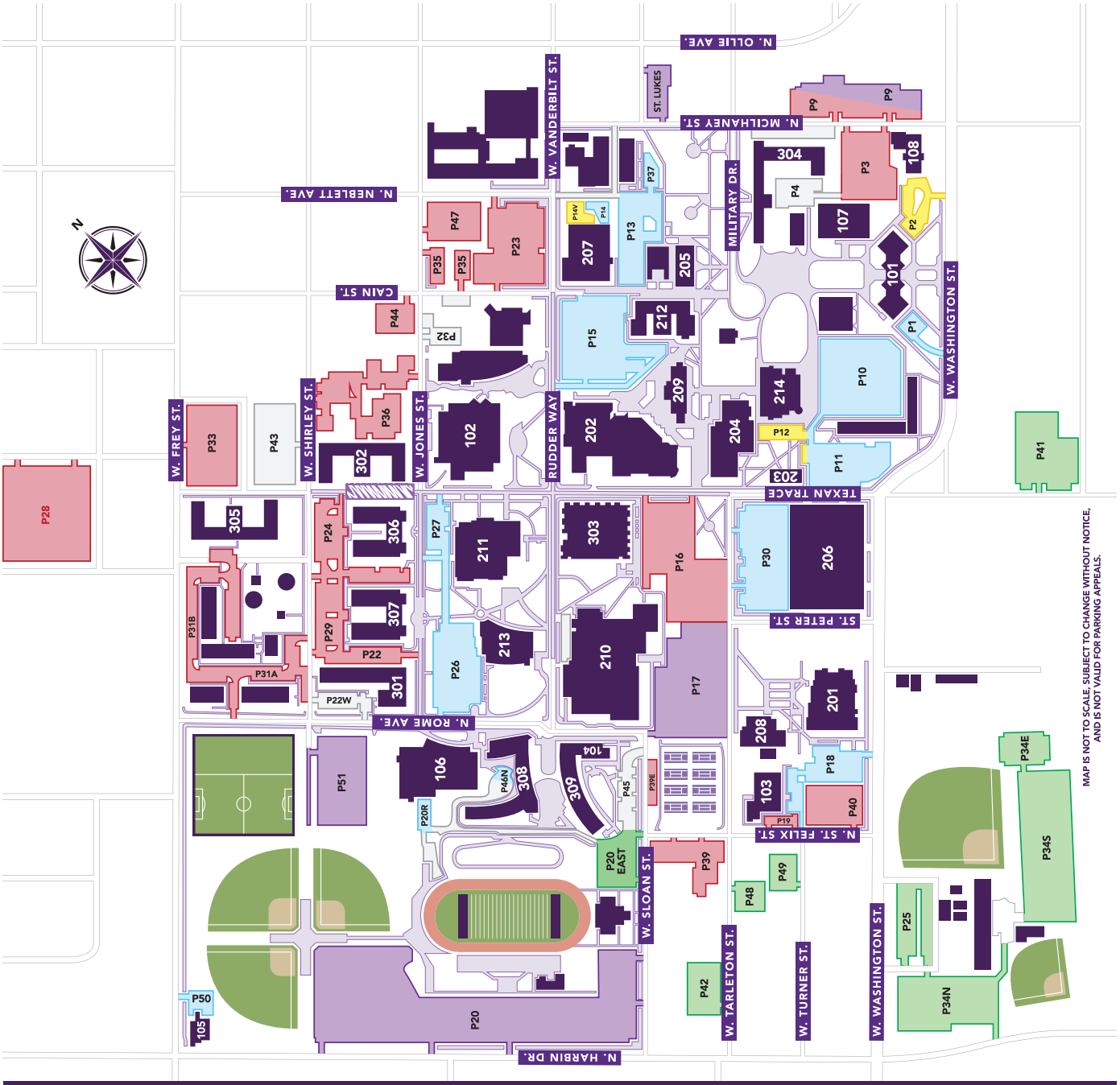
102^{nd} Annual Meeting of the Texas Section of the Mathematical Association of America

Tarleton State University

Stephenville, TX

March 23-25, 2023



ADMINISTRATIVE BUILDINGS
101 Administration Building
102 Barry B. Thompson Student Center
103 Central Receiving
104 Military Services
105 Police Department
106 Recreational Sports Center
107 Tarleton Center
108 Welcome Center

ACADEMIC BUILDINGS
201 Business Building
202 Clyde H. Wells Fine Arts Center
203 Davis Hall
204 Dick Smith Library
205 E.J. Howell Education Building
206 Engineering Building
207 Engineering Technology Building
208 Hydrology and Engineering
209 Joe W. Autry Agriculture Building
210 Kinesiology
211 Lamar Johnson Science Building
212 Math Building
213 Nursing Building
214 O.A. Grant Humanities Building

RESIDENCE HALLS
301 Centennial
302 Heritage
303 Honors
304 Hunewell
305 Integrity Hall
306 Legacy
307 Legends
308 Traditions Hall North
309 Traditions Hall South

PARKING LOT LEGEND
Residential Parking
Commuter Parking
All-Zone Parking
Faculty & Staff Parking
Open M-F after 5 p.m. and before 6 a.m, Weekends are open all day
Visitor Parking
24-hr Reserved
Heritage Hall Pedestrian Mall
Pedestrian Walkways

Please follow all parking rules and laws. Parking outside of the highlighted areas may result in a parking ticket.

An interactive map of Tarleton is available at **map.tarleton.edu.**

Program Contents

Conference Overview

Thursday, March 23, 2023 - Overview of Events			
4:00 p.m.	-	6:00 p.m.	Registration Math Building Lobby
4:00 p.m.	-	6:00 p.m.	Executive Council Meeting Math 337
4:00 p.m.	-	6:00 p.m.	Math Games First floor Math Building
6:00 p.m.	-	6:30 p.m.	Pizza First Floor Math 125
6:30 p.m.	-	9:30 p.m.	Math Bowl First floor Math Building

Friday, March 24, 2023 - Overview of Events			
7:30 a.m.	-	11:00 a.m.	Registration Math Building Lobby
8:00 a.m.	-	9:40 a.m.	Breakout sessions (Student) Math Building
8:00 a.m.	-	9:40 a.m.	NExT Math 310
9:50 a.m.	-	10:00 a.m.	Welcome Thompson Student Center Ballrooms
10:00 a.m.	-	10:55 a.m.	Plenary Address – Dr. Talithia Williams Thompson Student Center Ballrooms
11:00 a.m.	-	11:55 a.m.	Student Forum – Dr. Ed Burger Thompson Student Center Ballrooms
11:00 a.m.	-	1:30 p.m.	T3AMS Thompson Student Center 130
12:00 p.m.	-	1:20 p.m.	Lunch Dining Hall / on your own
12:00 p.m.	-	1:20 p.m.	NExT Lunch Thompson Student Center 027
12:00 p.m.	-	1:20 p.m.	T3AMS Lunch/Dept Liaisons Thompson Student Center 130
1:30 p.m.	-	4:20 p.m.	Breakout sessions (Faculty/Grad) Math Building
1:30 p.m.	-	4:00 p.m.	NExT Math 310
4:30 p.m.	-	5:15 p.m.	Grad Fair Math Building
5:30 p.m.	-	8:30 p.m.	Banquet Thompson Student Center Ballrooms

Saturday, March 25, 2023 - Overview of Events - Thompson Student Center Ballrooms			
8:00 a.m.	-	8:45 a.m.	Business meeting
9:00 a.m.	-	9:45 a.m.	Teaching Presentation – Dr. Mehmet Celik Thompson Student Center Ballrooms
9:45 a.m.	-	10:00 a.m.	20 years of NREUP Celebration
10:00 a.m.	-	10:55 a.m.	Plenary Address – Dr. Della Dumbaugh Thompson Student Center Ballrooms
11:00 a.m.	-	11:55 a.m.	Plenary Address – Dr. Hortensia Soto Thompson Student Center Ballrooms
11:55 a.m.	-	12:00 p.m.	Resolutions

Welcome and Special Thanks

Welcome!

Welcome to the 102^{nd} Annual Meeting of the Texas Section of the Mathematical Association of America! We would like to thank all of the speakers, attendees, and contributors to the conference. We hope you enjoy all of the sessions and receive valuable information that you can share with your colleagues. We welcome you to Tarleton State University, and Stephenville, TX. We anticipate that you will have a wonderful experience. Please let us know if we can assist you in any way.

Dr. Eileen Faulkenberry
Chair, MAA-TX

Mr. Michael Warren
Local Arrangements Chair

Special Thanks

Program Layout: A special thank you to Dr. Keith Emmert for his hard work preparing the layout and contents of the program booklet.

Student Activities Committee: Dr. Chris Mitchell, Mr. John Robinett, and Mrs. Shayla Hoffman.

Exceptional Thanks go to all the faculty and staff of the Tarleton State University Mathematics Department, who have contributed in many ways, great and small, to ensure the success of this conference.

Keynote Speakers

Dr Talithia Williams - Associate Professor of Mathematics and Mathematics Clinic Director at Harvey Mudd College

Plenary Address: Friday, 10:00 a.m. - 10:55 a.m., Thompson Student Center Ballrooms

The Power of Talk: Engaging the Public in Mathematics

Abstract: When it comes to inspiring the future productivity and innovation of our nation, mathematicians are the on the front lines. In this talk, I will discuss the importance of engaging a wide range of audiences in conversations about the nature of our work and of scientific discovery. As we change the way communities think about the natural world and the STEM disciplines, we can begin conversations that improve public perception of science and bring people from all backgrounds into this important work.

Biography: Talithia Williams, PhD, Associate Professor of Mathematics and Mathematics Clinic Director, develops statistical models which emphasize the spatial and temporal structure of data, and applies them to problems in the environment. She has partnered with the World Health Organization in developing a cataract model used to predict the cataract surgical rate for countries in Africa. Her research interests also include nonstationary covariance estimation and change-of-support problem.

Williams takes sophisticated numerical concepts and makes them understandable and relatable to everyone. As illustrated in her popular TedTalk, "Own Your Body's Data," she demystifies the mathematical process in amusing and insightful ways, using statistics as a way of seeing the world in a new light and transforming our future through the bold new possibilities inherent in the STEM fields. As an Associate Professor of Mathematics at Harvey Mudd College, she has made it her life's work to get people—students, parents, educators and community members—more excited about the possibilities inherent in a STEM education.

Williams received her B.S. in mathematics from Spelman College, master's degrees in both mathematics from Howard University and statistics from Rice University, and a PhD in statistics from Rice University. Her professional experiences include research appointments at the Jet Propulsion Laboratory (JPL), the National Security Agency (NSA), and NASA.

Dr. Edward Burger - President and CEO of the St. David's Foundation, and President Emeritus of Southwestern University as well as Professor Emeritus of Mathematics and a leader on thinking, innovation, and creativity

Student Forum: Friday, 11:00 a.m. - 11:55 a.m., Thompson Student Center Ballrooms

Paper folding for the origamically challenged: Uncovering beauty and structure through effective thinking

Abstract: Do you need the artful dexterity to create an aesthetic origami swan or dinosaur to appreciate the structure and beauty hidden within the folds of a piece of paper? Thank goodness, that answer is NO! All that is required is effective thinking and the ability to explore our world through a mathematical mindset.

Here, in just six Acts and one Intermission we, together, will not only discover beauty but also uncover secrets and structure all within the folds of your own folded sheet of paper. No advanced origami or mathematical background is required. Paper for folding will be provided.

Biography: Dr. Edward Burger is President and CEO of the St. David's Foundation, and President Emeritus of Southwestern University as well as Professor Emeritus of Mathematics and a leader on thinking, innovation, and creativity. Previously he was the Francis Christopher Oakley Third Century Professor of Mathematics at Williams College. He has delivered over 700 addresses worldwide at venues including Berkeley, Harvard, Princeton, and Johns Hopkins as well as at the Smithsonian Institution, Microsoft Corporation, the World Bank, the International Monetary Fund, the U.S. Department of the Interior, the U.S. Department of the Treasury, the New York Public Library, and the National Academy of Sciences. He is the author of over 70 research articles, books, and video series (starring in over 8,000 on-line videos), including the book T*he 5 Elements of Effective Thinking*, published by Princeton University Press and translated into over a dozen languages worldwide. His latest book, *Making Up Your Mind: Thinking Effectively Through Creative Puzzle-Solving*, also published by Princeton University Press, was on several of Amazon's Hot New Releases lists.

In 2006, Reader's Digest listed Burger in their annual "100 Best of America" as *America's Best Math Teacher*. In 2010 he was named the winner of the *Robert Foster Cherry Award* for Great Teaching—the largest prize in higher education teaching across all disciplines in the English-speaking world. The Huffington Post named him one of their *Game Changers* and Microsoft Worldwide Education selected him as one of their "Global Heroes in Education." In 2013, Burger was inducted as an inaugural *Fellow of the American Mathematical Society*. His program, *Higher ED*, produced by NPR's Austin affiliate KUT is available at kut.org/topic/higher-ed/ and on iTunes.

Dr. Mehmet Celik - Associate Professor of Mathematics at Texas A&M University-Commerce*

Teaching Talk: Saturday, 9:00 a.m. - 9:45 a.m., Thompson Student Center Ballrooms

Complex Numbers in Daily Life, Science, and Mathematics

Abstract: In one of the University Lecture Series, Peter D. Lax and Lawrance Zaleman pointed out that the three most effective problem-solving devices in mathematics are calculus, complex variables, and the Fourier transform. This presentation will introduce complex variables and present exciting applications in daily life, sciences, and mathematics.

Biography: Mehmet Celik is an Associate Professor of Mathematics at Texas A&M-Commerce. His research interest is in complex analysis and exploring mathematics teaching methodologies. He values collaborations with undergraduate students. At A&M-Commerce, Mehmet has sponsored Math Clubs, taken part in training math teams, served as PiMuEpsilon Chapter Advisor, and participated in extracurricular and outreach events. He has developed a signature course for the College of Innovation & Design for the development of mathematical intuition. At A&M-Commerce, besides mentoring honors and master students in research projects, he has taken students to conferences and served as a judge for undergraduate students' presentations. Mehmet also co-hosted twice the MAA's NREU Program and served as a mentor in the program. He also acted as a mentor during the 2022 Polymath Jr., an online undergraduate research program in mathematics. He currently serves as Texas Section Representative to the Congress of MAA.

Dr. Della Dumbaugh - Professor of Mathematics at the University of Richmond and Editor of the *American Mathematical Monthly*

Plenary Address: Saturday, 10:00 a.m. - 10:55 a.m., Thompson Student Center Ballrooms

Every Paper Tells a Story: Reflections on the Monthly

Abstract: Over its 128-year history, the *American Mathematical Monthly* has not only featured a wide array of mathematics on its pages but also a host of other insights related to the discipline. From Nobel prize winning ideas to careers inspired by a local drugstore to mathematical menus created by students, this talk showcases the riches of the *Monthly* and what we can learn about the profession. This talk also includes tips for publishing in the journal today.

Biography: Della Dumbaugh is a Professor of Mathematics at the University of Richmond and Editor of the *American Mathematical Monthly*. She feels at home in a mathematics classroom where her teaching has been celebrated by the University of Richmond, the State Council of Higher Education of Virginia, and the Mathematical Association of America. Along with her friend and collaborator, Deanna Haunsperger, she recently published *Count Me In: Community and Belonging in Mathematics*. She enjoys writing letters the old fashioned way, exercising, and spending time with her family.

Dr. Hortensia Soto - Professor of Mathematics at Colorado State University

Plenary Address: Saturday, 11:00 a.m. - 11:55 a.m., Thompson Student Center Ballrooms

***C**ompassion in **A**ccess to **L**earning **M**athematics (**CALM**)*

Abstract: Research indicates that students from minoritized groups are more likely to pursue STEM degrees if they can see how these fields benefit their communities and if they are in classrooms where they experience micro or macro-affirmations. In this presentation, I will share my perspectives, based on research and personal experiences, on how we can create learning environments that provide our students access to learning mathematics. I argue that we can help students see the value of mathematics by challenging them, providing a supportive learning environment, and creating a space where they have a voice in their learning.

Biography: Hortensia is a Professor of Mathematics at Colorado State University. She has been a member of the MAA since 1989. In 1996, as a Project NExT fellow, she became an involved member and in 2002 she began her role as a working member of the MAA. Her first working role was as the Governor for the Rocky Mountain Section; this led to serving on numerous MAA committees. Such committees include the Strategic Planning Committee Finance Working Group, the Minicourse Committee, and the Carriage House Advisory Board. She later served as secretary/treasurer of her section and the Governor for Minority Representation, which led to serving on the Committee for Professional Development.

She first became a member of the Executive Committee in 2013, when she began her 4-year term as the Associate Treasurer, which included serving on the Budget Committee (as chair), the Investment Committee, and the Compensation Committee. Currently, she serves as the Associate Secretary where she primarily organizes the annual meetings. She has also served as the Chair and Treasurer of the SIGMAA on RUME. Furthermore, her expertise in mathematics education was instrumental in creating the *MAA Instructional Practices Guide*. Most recently, she received the MAA Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics.

As a mathematics educator, Hortensia has published in various areas of mathematics education including assessment, mathematical preparation of elementary teachers, outreach efforts for high school girls, and especially in the area of teaching and learning of undergraduate mathematics. Her current research efforts are dedicated to investigating the teaching and learning complex analysis, where she adopts an embodied cognition perspective and is part of the Embodied Mathematics Imagination and Cognition community. Since her days as an undergraduate student, Hortensia has mentored young women and promoted mathematics via summer outreach programs. She has also been involved with facilitating professional development for K-16 teachers in Nebraska, Colorado, and California. Currently, she is delivering professional development to collegiate teachers as part of *Project PROMESAS SSC* (Pathways with Regional Outreach and Mathematics Excellence for Student Achievement in STEM).

Overview of Sessions

Room	8:00 - 8:15	8:20 - 8:35	8:40 - 8:55	9:00 - 9:15	9:20 - 9:35
109	*Cramer's Rule*	*Using Plane and Space Curves to Square a Circle*	*How accurately did Van Eyck paint the chandelier in the Arnolfini Portrait? A geometric analysis contributing to a decades old debate*	*Applying Linear Algebra to Penrose Tilings*	*Modeling Supraventricular Tachycardia Using Dynamic Computer-Generated Left Atrium*
	Austin Brewer	Luis Cruz	Oliver Johnson	Zek Mccormick	Gavin McIntosh, Avery Campbell
	Hardin-Simmons University	**University of Houston Downtown**	**Southwestern University**	**Southwestern University**	**Tarleton State University**
208	*Neural Network Models to Predict Voting Behavior of Minority Groups from the American Community Survey*	*Using Bayesian Methods to Infer Parameters for ODE Models of Disease Spread*	*The Kelly Criterion and the Stock Market*	*What is the smallest area? A parabolic parable*	*Mathematical Application in JAVA*
	Vianey Rangel, Cody Drolet	Derek Hopkins, Kyle Earp	Kaitlynn Harrylal	Aaron Garza, Kaiden Salaz	Rohith Reddy Dasi Reddy
	Tarleton State University	**Tarleton State University**	**St. Edward's University**	**Southwestern University**	**Hardin-Simmons University**
209	*Campus-wide Data-informed Collaboration to Create Tarleton's Peer & Aspirant List*	*An ODD Look at Theorems in Differential Equations*	*Infinitely Many Solutions of a Singular Semilinear Equation on Exterior Domains*	*Agreement proportion and boxicity for (2, 3)-agreeable box societies*	*Critical Numbers, Zeros, and Centroids*
	Aurod Ounsinegad	Emma Lewis, Jillian Reese	Hunter Baird, Ali Diwan, Luis Vazquez	Peyton Slepekis	Kyle Earp
	Tarleton State University	**Southwestern University**	**University of North Texas**	**Saint Edward's University**	**Tarleton State University**
212	*A New Euler-Like Partition Identity*	*Generalized Splines on Arbitrary Graphs*	*An Exploration of Difference Distance Magic Graph Labelings*	*Subtractive Edge Magic Labelings*	*Domino Antimagic Configurations*
	David Hovey	Makayla Hall, MarcAnthony Cantu, Camryn Sanders, Estela Sanchez	Kathryn Altman, Lauren Calzado	Alley Koenig, Casandra Nunez	Anderson Johnson, Paige Thompson, Kyla Gorman
	South Texas ISD Science Academy	**Sam Houston State University**	**Southwestern University**	**Southwestern University**	**Southwestern University**
213	*Solving Sudoku Puzzles Through Linear Algebra*	*Using Twitter to Predict Wordle Scores*	*A Mathematical Model of Onchocerciasis Resistance and Treatment*	*GPU-accelerated n-body simulation of spinning particle pairs in complex plasma crystals*	*Dynamics of Eastern Equine Encephalitis Infection Rates: A Mathematical Approach*
	Isabella Robinson, Oliver Johnson	Lauren Engelthaler, James Latour	Dashon Mitchell	Zachary Watson, Samuel Garcia-Rodriguez	Aurod Ounsinegad
	Southwestern University	**University of Dallas**	**Tarleton State University**	**Tarleton State University**	**Tarleton State University**

Room	1:30 - 1:45	1:50 - 2:05	2:10 - 2:25	2:30 - 2:45
208			*Complex Geometric Approach and Technique For Modular Arithmetic* Yujin Yoshimura **University of North Texas**	*The structure of Frobenius groups* Blake Norman **University of North Texas**
209	*Anomaly Detection in the USDA Crop Insurance Program* Scott Cook **Tarleton State University**	*Host switching vs. host sharing in overlapping sylvatic Trypanosoma cruzi transmission cycles* Christopher Mitchell **Tarleton State University**	*Minimizing Improper Payments in ER Claims using Random Forests* Jesse Crawford **Tarleton State University**	*How to Cheat at Blackjack and Probability* Dennis Hall **Angelo State University**
212	*A Modern Spin on Archimedes' Quadrature of the Parabola* Jason Snyder **Collin College**		*Partition Congruences and Cranks* Brandt Kronholm, David Hovey, Paul Marsh **University of Texas Rio Grande Valley**	*Too Many Triangles!* Richard Winton **Tarleton State University**
213	*The effect of Blended Learning Implementation on student Performance in a Pre-calculus course* Hanan Kuzat **Texas A&M University-Commerce**	*Co-Requisite Model at TAMUC* Pamela S. Webster **Texas A&M University - Commerce**	*A Preliminary Report on Students' Reflections about Their Learning in an Active Learning Classroom* Su Liang, Tina Vega **University of Texas at San Antonio**	*Bringing the SCUDEM Experience To The Classroom* John Ehrke **Abilene Christian University**

Room	3:00 - 3:15	3:20 - 3:35	3:40 - 3:55	4:00 - 4:15
208	*THE UNIMODALITY OF GAUSSIAN POLYNOMIALS FOR A FEW MORE SMALL VALUES OF M.*	*How mathematics has helped me in my career.*	*Alarming Decrease in Math Majors*	*The Turn of Some Friendly Cards and other Math Magic Tricks and Puzzles*
	Paul Marsh	Kelly Francis	Tingxiu Wang	Kris Jorgenson
	University of Texas at Rio Grande Valley	**Cummings Aerospace**	**Texas A&M University-Commerce**	**Sul Ross State University**
209	*Embedding a Quantum Rank Two Quadric in a Quantum P^3*	*The Cubic Formula and Why We Don't Teach It*	*Semidisjoint Permutations*	*College Algebra Proof of FTA*
	Richard Chandler	Andrew Jay Potter	Richard Winton	Franklin Kemp
	University of North Texas at Dallas	**Hardin-Simmons University**	**Tarleton State University**	**(Co)Sine Clock Company**
212	*Gamma function approximations for computing closed-form Bayes factors*	*Visualizing Eigenvalues and Eigenvectors*	*Infinitely Many Solutions of a Semilinear Equation*	*CAM Cans - Computer Aided Mathematics and Packing Right Circular Cylinders*
	Tom Faulkenberry	John Gresham, Michael Warren, Bryant Wyatt	Joseph Iaia	Peter White, Bowen Brawner
	Tarleton State University	**Tarleton State University**	**University of North Texas**	**Tarleton State University**
213	*Lecturing or Interaction - You Don't Have to Pick Just One!*	*Math and Magic in College Courses*	*MY Math Apps Calculus*	*Standardization in Multi-Section Mathematics Courses*
	Shayla Hoffman, Courtney Holland	Ricardo V Teixeira	Philip Yasskin	Beth Riggs
	Tarleton State University	**University of Houston - Victoria**	**Texas A&M University**	**Tarleton State University**

Full Session Descriptions

Cramer's Rule

Time: 8:00 - 8:15 **Algebra and Number Theory** **Room: 109**

Austin Brewer *Hardin-Simmons University*

This presentation looks at a method to solving n linear equations with n variables, using matrices and their determinants, otherwise known as Cramer's rule. It will also give a brief overview of Gabriel Cramer's life and work in mathematics.

Neural Network Models to Predict Voting Behavior of Minority Groups from the American Community Survey

Time: 8:00 - 8:15 **Applied Mathematics** **Room: 208**

Vianey Rangel *Tarleton State University*

Cody Drolet *Tarleton State University*

The 1965 Voting Rights Act mandates minority opportunity voting districts that allow significant racial minority groups to elect a "candidate of choice". Subsequent court cases like Thornburg v Gingles established legal tests to assess the necessity and effectiveness of such districts which rely on evidence of racially polarized voting. However, it has proven difficult to accurately quantify the degree of polarization and whether a putative minority opportunity district is truly functioning as intended. In a large and rapidly evolving state like Texas, prior election results and traditional assumptions of monolithic blocks voting do not accurately predict current and future voting behaviors, especially among Hispanics. We present a new neural network-based statistical model that accurately predicts voting participation and preference of racial groups in Texas at the level of voting tabulation districts. It is based solely on publicly available data from the US Census Bureau's annual American Community Survey (ACS) and the Texas Legislative Council while not relying on polling data. It leverages demographic and socio-economic data (population density, income, high school completion, homeownership, etc.) from ACS to predict results using statewide elections from 2016-2022. The best models accurately predict these elections within 2%-4% error and perform equivalently well across all parts of Texas.

Campus-wide Data-informed Collaboration to Create Tarleton's Peer & Aspirant List

Time: 8:00 - 8:15 **Analysis** **Room: 209**

Aurod Ounsinegad *Tarleton State University*

Tarleton's new strategic plan, Tarleton Forward 2030 (TF30), sets ambitious goals for growth, expansion, and improvement that require a new list of Peer and Aspirant institutions (P&A) to benchmark progress. Since TF30 calls for improved use of data for predictive analytics and strategic decision-making, we took a deliberately data-informed and collaborative approach led by the Math Department with direct input from our president, vice presidents, director of institutional research, and many other campus leaders. The Integrated Postsecondary Education Data System (IPEDS), which collects >250 statistics on >7000 colleges and universities across the United States, serves as the primary data source. We present our methodology to filter down to 133 comparable schools and create a metric to rank order them relative to Tarleton. This process highlights many familiar elements of the data science process including feature selection & engineering, rescaling, dimensionality reduction, weighted averaging, and rank ordering. This project also highlights some less common phenomena on university campuses: - Effective and amicable collaboration between administration, faculty, and students - Respect for the primacy of data - Earnest cooperation across all divisions, including academics, athletics, finance, enrollment management, research, student affairs, and university strategy

A New Euler-Like Partition Identity

Time: 8:00 - 8:15 **Discrete Mathematics** **Room: 212**

David Hovey *South Texas ISD Science Academy*

In this talk we prove an Euler-like partition identity that we have not yet found in the literature. Before we establish this new identity, we provide a short introduction to generating functions, a powerful tool used to study partitions.

Solving Sudoku Puzzles Through Linear Algebra

Time: 8:00 - 8:15 **Applied Mathematics** **Room: 213**

Isabella Robinson *Southwestern University*

Oliver Johnson *Southwestern University*

Sudoku is a popular logic puzzle made from square grids in which each value space must be filled with non-repeating numbers in each row, column or sub-grid. A proper sudoku puzzle has a unique solution and can be solved using pure logic. This research explores a linear algebra approach to solving sudoku puzzles, which has particular advantages and disadvantages. We also introduce a new variant of the puzzle and explore its solutions.

Using Plane and Space Curves to Square a Circle

Time: 8:20 - 8:35 **Geometry and Topology** **Room: 109**

Luis Cruz *University of Houston Downtown*

My presentation reviews a few significant discoveries throughout history pertaining to geometry. I will specify with mathematicians such as Pythagoras, Euclid, Hippias, Archimedes, and Apollonius. These mathematicians created the branch of mathematics known as "geometry" today. This field of mathematics helped establish many important proofs such as Pythagorean theorem, mean proportional, and angle bisection. However, there were three problems that they were not able to solve with straightedge and compass; cube duplication, angle trisection, and quadrature of a circle. These problems are now known as the "Problems of Antiquity". My presentation will dive into the third one, how to find a square with equal area to a circle. Hippias, Archimedes, and Apollonius are credited for the discovery or contributing work of the quadratrix, spiral, and helix respectively. The first two are plane curves and the latter is a space curve. These curves can be used to find the quadrature of a circle. I will go over why these solutions were rejected by mathematicians. I will also point out the logical circularity with the genesis of each curve. For example, pi is required for constructing each curve, but if we assume the knowledge of pi then we can square the circle directly.

Using Bayesian Methods to Infer Parameters for ODE Models of Disease Spread

Time: 8:20 - 8:35 **Probability and Statistics** **Room: 208**

Derek Hopkins *Tarleton State University*

Kyle Earp *Tarleton State University*

Classical models of disease outbreaks rely on systems of nonlinear ordinary differential equations. ODE models have been widely successful and are credited with saving millions of lives worldwide. However, ODE models involve parameters that are often poorly understood and difficult to infer from limited and noisy data. This is especially problematic for rare, novel, or neglected diseases with unreliable reporting mechanisms.

While some parameters can be deduced from biological or social facts, many must be inferred from data. Traditional least-squares point-estimates are fragile when applied to noisy data common in disease modeling. Bayesian inference replaces fragile point-estimates with posterior distributions that are more robust against data quality issues. Whereas point-estimate models produce a single outbreak forecast, Bayesian models generate an ensemble of forecasts through repeatedly sampling model parameters from their posterior distributions and numerically solving the resulting ODE. These multiple forecasts can be pooled and statistically analyzed at each time step (min, max, mean, etc) to give insight into potential outbreak scenarios (best-case, worst-case, most likely, resp).

An ODD Look at Theorems in Differential Equations

Time: 8:20 - 8:35 **Analysis** **Room: 209**

Emma Lewis *Southwestern University*

Jillian Reese *Southwestern University*

We consider the class of second order differential equations $u'' + f(u) = 0$ including those for which f is an odd function. We examine some function characteristics and boundary conditions. We will present some theorems and their proofs. This work was funded by a grant from the Council for Undergraduate Research in Mathematics with research groups from two institutions.

Generalized Splines on Arbitrary Graphs

Time: 8:20 - 8:35	**Discrete Mathematics**	**Room: 212**
Makayla Hall		*Sam Houston State University*
MarcAnthony Cantu		*Sam Houston State University*
Camryn Sanders		*Sam Houston State University*
Estela Sanchez		*Sam Houston State University*

Consider a graph G with edges defined by monomial ideals in the polynomial ring R for two variables with integer coefficients. A generalized spline was introduced by Gilbert, Polster, and Tymoczko as a label on the vertices in such a way that the difference between any two adjacent vertices is congruent modulo the edge label. For a graph, the collection of splines forms an R-module. During our research we each focused on certain types of graphs and found individual methods for finding a basis for our graphs, as well as a general structure of what the basis will look like for an arbitrary graph. Our findings showed that the basis for an arbitrary graph will consist of splines that contain only zeros and a possibly repeating monomial term determined by the edge labels on the graph. This presentation explores methods of creating a basis for the R-module of generalized splines.

Using Twitter to Predict Wordle Scores

Time: 8:20 - 8:35	**Applied Mathematics**	**Room: 213**
Lauren Engelthaler		*University of Dallas*
James Latour		*University of Dallas*

With the growing popularity of Wordle over the past year, many users have taken to reporting their scores on Twitter. Using this Twitter data, we develop a model to predict the distribution of Wordle scores for a given daily puzzle. We approach this problem by performing a regression on various characteristics of past Wordles, while using the design of the game to generate predictions apart from the data. Additionally, we look for trends among the players playing in 'hard mode'.

How accurately did Van Eyck paint the chandelier in the Arnolfini Portrait? A geometric analysis contributing to a decades old debate

Time: 8:40 - 8:55	**Mathematics Art**	**Room: 109**
Oliver Johnson		*Southwestern University*

In 1434, Jan Van Eyck completed what is known to be one of his most important paintings: The Arnolfini Portrait, an influential work of art due in part to its early achievements in the realistic representation of space. There have long been debates over the methodologies used to paint the Arnolfini Portrait, most famously whether or not he used a perspective device, the so-called Hockney-Falco Thesis. We dig deeper into the arguments regarding the perspectival correctness of the chandelier centrally located within the composition and use more advanced perspective techniques to assess the accuracy of Van Eyck's representation, to ultimately provide further information to the discussion considering the use of a perspectival device in the realization of the Arnolfini Portrait.

The Kelly Criterion and the Stock Market

Time: 8:40 - 8:55 **Probability and Statistics** **Room: 208**

Kaitlynn Harrylal *St. Edward's University*

Investing in the US stock market is much like a gambling game based on calculated risks. The Kelly Criterion method helps investors and gamblers to calculate what percentage of their money they should allocate to each investment or bet. In this research, we analyze the volatility of the S & P 500 stocks from 1962-1991 and 1992-2021 to find the optimal amount to invest to maximize gains as well as the amount that will lead to inevitable ruin.

Infinitely Many Solutions of a Singular Semilinear Equation on Exterior Domains

Time: 8:40 - 8:55 **Analysis** **Room: 209**

Hunter Baird *University of North Texas*

Ali Diwan *University of North Texas*

Luis Vazquez *University of North Texas*

We discuss $L(u) + K(r)f(u) = 0$ where $L(u)$ is the Laplacian of u, $K(r) \sim r^{-c}$ with $c > 0$, and $f(u) \sim u^{-q} + u^p$ with $0 < q < 1 < p$ on the exterior of the ball of radius R. We prove existence of two infinite families of solutions with $u(R) = 0$ and $u(r)$ tending to 0 as r tends to infinity.

An Exploration of Difference Distance Magic Graph Labelings

Time: 8:40 - 8:55 **Discrete Mathematics** **Room: 212**

Kathryn Altman *Southwestern University*

Lauren Calzado *Southwestern University*

An oriented graph with n vertices has a difference distance magic (DDM) labeling if it is possible to label the vertices with distinct values from $\{1, 2, ..., n\}$ such that at each vertex the sum of the labels of vertices from the in-neighborhood is equal to the sum of the labels of vertices from the out-neighborhood. In this talk, the properties that must be true in order for various classes of oriented graphs to have DDM labelings will be examined. Some classes we may discuss include wheels, multipartite graphs, and regular graphs. In addition, we will discuss how bidirectional edges can create additional DDM labelings. The talk will conclude with a connection to creating home-away equalized tournaments.

A Mathematical Model of Onchocerciasis Resistance and Treatment

Time: 8:40 - 8:55 **Applied Mathematics** **Room: 213**

Dashon Mitchell *Tarleton State University*

Onchocerciasis is a parasitic disease endemic in Sub-Saharan Africa and South America that spreads from black flies to humans. The disease causes skin nodules, itching, and in severe cases, permanent blindness; Contributing to its nickname, River Blindness. The World Health Organization's current approach to Onchocerciasis is mass drug administration of Ivermectin. The first issue concerns the effectiveness of onchocerciasis on the affected population. The world health organization has been using this treatment for around 40 years and has only seen elimination in a few countries, while other countries have only seen the situation get worse. The second issue is that mass distribution of ivermectin may lead to resistance to that treatment so the WHO's plan may be doing more harm than good within these afflicted counties. Because of these issues the goal of our project will be to model the spread of Onchocerciasis with resistance, analyze the impact of possible Ivermectin resistance and figure out an alternative treatment plan with doxycycline that can eliminate the disease without causing widespread resistance. After obtaining this goal we hope to expand the model to include Loiasis, another eye worm disease that may cause death when taking ivermectin.

Applying Linear Algebra to Penrose Tilings

Time: 9:00 - 9:15 **Mathematics Art** **Room: 109**

Zek Mccormick *Southwestern University*

An aperiodic tiling is one that will tile the plane infinitely without repeating itself. The purpose of this research is to apply linear algebra to the most famous of aperiodic tilings, Penrose tilings. Penrose tilings along with their variants can be created using composition and decomposition of triangles, and matrices can be used to quantify the number of each triangle type created after each decomposition. These matrices along with their eigenstructure can be used to determine the tiling's properties, and illuminate how the Golden ratio inherent in this structure plays a role.

What is the smallest area? A parabolic parable

Time: 9:00 - 9:15 **Applied Mathematics** **Room: 208**

Aaron Garza *Southwestern University*

Kaiden Salaz *Southwestern University*

Suppose we have n tangent lines and we want to use those tangent lines to get the best approximation of a parabola. Where should I place these tangent lines to minimize the area between the tangent lines and the parabola? This study aims to find a pattern in the minimization of the area under a parabola with n given tangent lines. By using Desmos, a pattern was uncovered for the parent function x^2 as the number of tangent lines increased. We will discuss how our results were verified using multidimensional calculus and next steps to generalize this process to any parabola.

Agreement proportion and boxicity for (2, 3)-agreeable box societies

Time: 9:00 - 9:15 **Discrete Mathematics** **Room: 209**

Peyton Slepekis *Saint Edward's University*

We use an upper bound on piercing numbers for axis-parallel boxes satisfying the property that of any 3 boxes, 2 overlap (i.e. the (3,2)-property or (2,3)-agreeability) to improve the lower bound on minimum agreement proportion for (2,3)-agreeable box societies. Additionally, we improve the lower bound on boxicity for such societies and show that it is sharp when the associated piercing number is less than six. We also demonstrate novel computational methods for determining the boxicity of (2,3)-agreeable societies and use these methods to rule out graphs satisfying various criteria from having boxicity 2.

Subtractive Edge Magic Labelings

Time: 9:00 - 9:15 **Discrete Mathematics** **Room: 212**

Alley Koenig *Southwestern University*

Casandra Nunez *Southwestern University*

We look into subtractive edge magic labelings of different directed graphs. A subtractive edge magic labeling of a directed graph with v vertices and e edges is an assignment of the vertices and edges to distinct values from $\{1, 2, ..., v + e\}$ such that the weight of each edge in the graph is the same. Here the weight of an edge is the sum of the edge label and the vertex label on the head minus the vertex label of the tail. We will begin by discussing some properties of subtractive edge magic directed graphs. Then, we will discuss some classes of graphs and whether or not they have subtractive edge magic labelings including complete bipartite graphs.

GPU-accelerated n-body simulation of spinning particle pairs in complex plasma crystals

Time: 9:00 - 9:15 **Applied Mathematics** **Room: 213**

Zachary Watson *Tarleton State University*

Samuel Garcia-Rodriguez *Tarleton State University*

Plasma is the collection of electrons and ions that forms when matter is subjected to extremely high temperatures. A complex plasma is an ionized gas that contains nanometer to micron-sized particles (dust). Dust grains collect more electrons than ions on their surface and become negatively charged. The action of this charged dust within the plasma environment has ramifications in a wide array of systems, such as self-assembly of nanostructures, removal of dust in semiconductor fabrication and fusion reactors, and as a planet formation mechanism in astrophysics. Researchers study the dust interaction with the flow of ions in a complex plasma by confining and levitating the charged dust grains in an electric field. Under proper conditions, the dust can self-arrange into a complex 2D configuration known as a complex plasma crystal. Torsion is a phenomenon observed in the crystal where pairs of particles spin. This is a possible mechanism of energy transfer for the crystal to transition between different dimensions and phases. Due to the cost and complexity of the experimental setups necessary to recreate and study torsions, researchers often rely on computer generated models to lead and confirm their findings. The interaction of dust grains in a complex plasma are suitable to be modeled using an n-body problem approach. We present our current work on dynamically simulating the formation of torsions in a complex plasma crystal using GPU-accelerated computing.

Modeling Supraventricular Tachycardia Using Dynamic Computer-Generated Left Atrium

Time: 9:20 - 9:35 **Other** **Room: 109**

Gavin McIntosh *Tarleton State University*

Avery Campbell *Tarleton State University*

Supraventricular Tachycardia (SVT) is when the heart's upper chambers beat either too quickly or out of rhythm with the heart's lower chambers. This out-of-step heart beating is a leading cause of strokes, heart attacks, and heart failure. The most successful treatment for SVT is catheter ablation, a process where an electrophysiologist (EP) maps the heart to find areas with abnormal electrical activity. The EP then runs a catheter into the heart to burn the abnormal area, blocking the electrical signals. Much is not known about what triggers SVT and where to place scar tissue for optimal patient outcomes. We have produced a dynamic model of the left atrium accelerated on NVIDIA GPUs. An interface will allow researchers to insert ectopic signals into the simulated atria and ablate sections of the atria allowing them to rapidly gain insight into what causes SVTs and how to terminate them.

Mathematical Application in JAVA

Time: 9:20 - 9:35 **Applied Mathematics** **Room: 208**

Rohith Reddy Dasi Reddy *Hardin-Simmons University*

Will demonstrate a real life mathematical application in JAVA. Will attempt to create the JAVA program live.

Critical Numbers, Zeros, and Centroids

Time: 9:20 - 9:35 **Analysis** **Room: 209**

Kyle Earp *Tarleton State University*

Preliminary material concerning the Generalized Product Rule for Derivatives is presented. A main theorem is developed which verifies that a polynomial $p(x)$ of degree 3 with 3 distinct real zeros has a unique critical number between each consecutive pair of zeros and no other critical numbers. It is established that the smallest critical number is closer to the smallest zero than the middle zero. Similarly, it is shown that the largest critical number is closer to the largest zero than the middle zero. Also, for each positive integer n, $fn(x) = x^n$ and its inverse $fn^{-1}(x) = x^{1/n}$ enclose a region Rn between (0,0) and (1,1). A general formula for the centroid Cn of the region Rn is obtained by deriving the coordinates (xn,yn) of Cn in terms of the parameter n (n $>$ 1).

Domino Antimagic Configurations

Time: 9:20 - 9:35 **Discrete Mathematics** **Room: 212**

Anderson Johnson *Southwestern University*

Paige Thompson *Southwestern University*

Kyla Gorman *Southwestern University*

An antimagic square is an n x n grid of integers (normally using the values 1 up to n^2) whose rows, main diagonals, and columns add up to distinct, consecutive integers. The k-domino set is the set of distinct domino tiles where the two numbers on each tile are any number from 0 to k. Recently, antimagic domino squares were defined as antimagic squares formed by using the standard 6-domino set. In this talk, we discuss what other antimagic configurations (not strictly limited to squares) can be constructed from a subset of the 6-domino set such that the sums of the rows and columns form a set of distinct, consecutive integers. We will restrict our domino configurations to using at most four different dominoes. We will also explore the minimum sized k-domino set that will create such configurations.

Dynamics of Eastern Equine Encephalitis Infection Rates: A Mathematical Approach

Time: 9:20 - 9:35 **Applied Mathematics** **Room: 213**

Aurod Ounsinegad *Tarleton State University*

The Eastern Equine Encephalitis virus (EEEV) is an erratic and deadly neurological disease that spans the northeastern coast of the United States and Canada. An analysis of the migration patterns of both the mosquito vector and the avian host species was conducted to determine the rate at which the virus is spread between the Black-Tailed Mosquito (Culiseta melanura) and select avian species. It was found that certain species of avians shared similar, or even identical, migration patterns with the Black-Tailed Mosquito. A system of ordinary differential equations (ODEs) was developed and analyzed to gain insight into the transmission dynamics of EEE between the two host classes. A host stage-structured model was incorporated where the avian host group is split into two categories, adults, and hatch-year avians. By using this, the extent to which fluctuations occurred in transmission rates according to host/vector abundances, mosquito biting rate, and type of host was explored. Elasticity analysis was then conducted on all parameters that form the basic reproductive number ($\mathcal{R}_0$) to find the parameters that cause the greatest change in $\mathcal{R}_0$. The hypothesis that is evaluated is that hatch-year avians are more readily exposed to the mosquito vector as they lack a defense mechanism, unlike their adult counterpart, allowing for a better understanding of how hatch-year avians drive the infection.

Anomaly Detection in the USDA Crop Insurance Program

Time: 1:30 - 1:45 **Applied Mathematics** **Room: 209**

Scott Cook *Tarleton State University*

Tarleton's Center for Agribusiness Excellence (CAE) has partnered with the United States Department of Agriculture's Risk Management Agency since 2001 providing advanced analytics and data mining in support of the Federal Crop Insurance Program. Credited with a total savings to US taxpayers of close to $2 billion, CAE is one of the most successful data mining projects within the federal government. CAE's remarkable ROI has been historically powered by traditional rules-based algorithms that hunt for well-known abusive practices that lead to improper payments.
In 2018, CAE brought modern machine learning techniques into the fight against crop insurance fraud by creating a data science research team in collaboration with the Tarleton Mathematics Department. In 2022, this interdisciplinary team created two major new algorithms called Multiply Marginal Producers (MMP) and County Yield Distribution Model (CYDM). Both are now deployed nationwide and automatically inspect the majority of crop insurance records for signs of anomalous behavior using data science tools like Bayesian inference and dimensionality reduction.
This talk will discuss how CAE's MMP and CYDM algorithms use machine learning to protect US taxpayers from waste, fraud, and abuse. We may also discuss ongoing efforts to use Google's BERT language model to enhance USDA's farm inspection processes (if time permits).

A Modern Spin on Archimedes' Quadrature of the Parabola

Time: 1:30 - 1:45 **Geometry and Topology** **Room: 212**

Jason Snyder *Collin College*

In a letter to Conon, Archimedes used his method of exhaustion to derive the area of a parabolic sector. In this talk, we will use the Differential Calculus to bring his derivation into modern times. This method is used to demonstrate, to Calculus students, how complex the area problem can be.

The effect of Blended Learning Implementation on student Performance in a Pre-calculus course

Time: 1:30 - 1:45 **Mathematics Education** **Room: 213**

Hanan Kuzat *Texas A&M University-Commerce*

Technology enables teaching and student learning in new and unique ways. Extant educational research has been heavily focused on comparison between learning methods, namely between face-to-face and blended learning environments. The purpose of this paper is to examine the difference in student academic achievement growth in Mathematics students in Texas A&M University in the Precalculus course. Using a convenient sampling method, student records were collected from four Precalculus courses. Of those, two were blended learning Pre-calculus courses, and two traditional learning Pre-calculus courses. The study revealed a significant difference in the student performance as measured by final course grade in Pre-calculus between those who attended the blended learning course and those who attended the traditional course. The study concludes that blended learning platforms may be effective tools for improving student performance in Mathematics courses. Keywords: Blended learning, traditional learning, performance, Texas A&M University, pre-calculus, Mathematics.

Host switching vs. host sharing in overlapping sylvatic Trypanosoma cruzi transmission cycles

Time: 1:50 - 2:05 **Applied Mathematics** **Room: 209**

Christopher Mitchell *Tarleton State University*

The principle of competitive exclusion is well established for multiple populations competing for the same resource, and simple models for multistrain infection exhibit it as well when cross-immunity precludes coinfections. However, multiple hosts provide niches for different pathogens to occupy simultaneously. This is the case for the vector-borne parasite Trypanosoma cruzi in overlapping sylvatic transmission cycles in the Americas, where it is enzootic. This study uses cycles in the USA involving two different hosts but the same vector species as a context for the study of the mechanisms behind the communication between the two cycles. Vectors dispersing in search of new hosts may be considered to move between the two cycles (host switching) or, more simply, to divide their time between the two host types (host sharing). Analysis considers host switching as an intermediate case between isolated cycles and intermingled cycles (host sharing) in order to examine the role played by the host-switching rate in permitting coexistence of multiple strains in a single-host population. Results show that although the population dynamics (demographic equilibria) in host-switching models align well with those in the limiting models (host sharing or isolated cycles), infection dynamics differ significantly, in ways that sometimes illuminate the underlying epidemiology (such as differing host susceptibilities to infection) and sometimes reveal model limitations.

Co-Requisite Model at TAMUC

Time: 1:50 - 2:05 **Mathematics Education** **Room: 213**

Pamela S. Webster *Texas A&M University - Commerce*

This talk will give data on the progress of the co-requisite model at Texas A&M University - Commerce, including data since the inception of the model in 2018. Lessons learned and current pilots will be discussed.

Complex Geometric Approach and Technique For Modular Arithmetic

Time: 2:10 - 2:25 **Algebra and Number Theory** **Room: 208**

Yujin Yoshimura *University of North Texas*

"Is $2^{2^n} + 3^{2^n} + 5^{2^n}$ divisible by 38, for any natural number n?" In number theory, we have modular arithmetic as a useful tool to attack problems that deals with divisibility. And this problem is a perfect example for using modular arithmetic. Among many ways to prove this problem, this presentation will focus on how to interpret modular arithmetic on complex numbers using geometry, how to prove efficiently, and why it works.

Minimizing Improper Payments in ER Claims using Random Forests

Time: 2:10 - 2:25 **Probability and Statistics** **Room: 209**

Jesse Crawford *Tarleton State University*

Improper health insurance payments resulting from fraud and upcoding result in tens of billions of dollars in excess health care costs annually in the United States, motivating machine learning researchers to build anomaly detection models for health insurance claims. This presentation describes two such strategies specifically for ER claims. The first is an upcoding model based on severity code distributions, stratified by hierarchical diagnosis code clusters. A statistically significant difference in mean upcoding anomaly scores is observed between free-standing ERs and acute care hospitals, with free-standing ERs being more anomalous. The second model is a random forest that minimizes improper payments by optimally sorting ER claims within review queues. Depending on the percentage of claims reviewed, the random forest saved 12% to 40% above a baseline approach that prioritized claims by billed amount.

Partition Congruences and Cranks

Time: 2:10 - 2:25 **Discrete Mathematics** **Room: 212**

Brandt Kronholm *University of Texas Rio Grande Valley*

David Hovey *University of Texas Rio Grande Valley*

Paul Marsh *University of Texas Rio Grande Valley*

In this presentation we establish infinite families of cranks witnessing infinite families of congruences for the function p(n,m) which enumerates partitions of n into at most m parts.
This is joint work with Acadia Larsen (UC Davis) and Dennis Eichhorn (UC Irvine).

A Preliminary Report on Students' Reflections about Their Learning in an Active Learning Classroom

Time: 2:10 - 2:25 **Mathematics Education** **Room: 213**

Su Liang *University of Texas at San Antonio*

Tina Vega *University of Texas at San Antonio*

College Algebra has become a big hurdle for students to graduate or further pursue STEM or related careers. In recent years, at a large Hispanic-serving university, the course design for liberal arts students has changed. An active-learning curriculum has been implemented, namely Quantitative Reasoning. This curriculum engages students with opportunities to learn math concepts from relevant everyday sources and even their own personally collected data. The purpose of this study was to investigate the impact that a course design with pre-assignment tasks, authentic problem-solving through collaboration in class, and practice assignments after lessons have on diverse student populations in a quantitative reasoning course.

The structure of Frobenius groups

Time: 2:30 - 2:45 **Algebra and Number Theory** **Room: 208**

Blake Norman *University of North Texas*

The study of Frobenius groups began in the late 19th century and concluded in the early 1960s. The study of these groups led to the initial development of character theory by Frobenius, advances in general group theory by Zassenhaus, and ended with John Thompson's celebrated dissertation. In this talk, we will provide an overview of the relevant definitions and results that lead to a precise description of the structure and uniqueness of the action of Frobenius groups.

How to Cheat at Blackjack and Probability

Time: 2:30 - 2:45 **Probability and Statistics** **Room: 209**

Dennis Hall *Angelo State University*

Should you hit or stand? When is the deck hot or cold? In this talk, we introduce Monte Carlo simulations and use them to test the effectiveness of card counting in blackjack. This talk is suitable for all undergraduate students, regardless of background.

Too Many Triangles!

Time: 2:30 - 2:45 **Geometry and Topology** **Room: 212**

Richard Winton *Tarleton State University*

For each ordered pair (m,n) of positive integers, T(m,n) is defined to be the number of triangles with prescribed properties which are contained in a predetermined mï¸´n rectangle. This paper will derive a general closed formula for T(m,n). Several increasingly refined formulas pertaining to an important special case are also developed.

Bringing the SCUDEM Experience To The Classroom

Time: 2:30 - 2:45 **Mathematics Education** **Room: 213**

John Ehrke *Abilene Christian University*

SCUDEM is the acronym given to the SIMIODE Challenge Using Differential Equations Modeling competition. 3-student groups are given approximately two weeks to formulate a model for a range of provided application prompts where submissions are judged by faculty remotely. In this talk, we give a brief overview of SIMIODE and SCUDEM, relay our experiences as a judge and coach for the SCUDEM challenge, and discuss our successes in adapting the SCUDEM format for practicum in an undergraduate differential equations course. Sample problem prompts and student experiences will be shared.

THE UNIMODALITY OF GAUSSIAN POLYNOMIALS FOR A FEW MORE SMALL VALUES OF M.

Time: 3:00 - 3:15 **Discrete Mathematics** **Room: 208**

Paul Marsh *University of Texas at Rio Grande Valley*

The Gaussian polynomials are a well-studied family of polynomials. One interesting property of the Gaussian polynomials is that their coefficients are unimodal, meaning that they form a sequence that first increases to a maximum value and then decreases. In this presentation, we will provide a proof of unimodality for the coefficients of a few infinite families of Gaussian polynomials. Working from the generating functions, we will derive formulas for the coefficients of Gaussian polynomials. Next, we use these formulas to create a collection of new generating functions that are then used to show unimodality.

Embedding a Quantum Rank Two Quadric in a Quantum P^3

Time: 3:00 - 3:15 **Algebra and Number Theory** **Room: 209**

Richard Chandler *University of North Texas at Dallas*

Previously, Vancliff, Shelton and Van Rompey have successfully classified all Artin-Schelter regular algebras of global dimension 4 that have a point scheme of a rank 3 or rank 4 quadric. We seek a similar classification for those algebras with a point scheme of a rank 2 quadric. In this preliminary report, we discuss the progress towards this classification thus far, including the classification of algebras whose point scheme is a rank 2 quadric union a line.

Gamma function approximations for computing closed-form Bayes factors

Time: 3:00 - 3:15 **Bayesian Statistics** **Room: 212**

Tom Faulkenberry *Tarleton State University*

In experimental designs, the evidence for a treatment effect can be nicely indexed by the Bayes factor, which expresses the relative likelihood of some observed data under the alternative hypothesis compared to the null hypothesis (or vice versa). While conceptually simple, computing the marginal likelihoods requires integrating over a prior distribution, and as such, Bayes factors usually involve integral representations. However, under a particular choice of prior, the Bayes factor admits an analytic representation (Wang & Liu, 2016; Faulkenberry, 2020) involving gamma functions. In this talk, I use three classic approximations of the gamma function to derive closed form approximations of the Bayes factor for two-group designs.

Lecturing or Interaction - You Don't Have to Pick Just One!

Time: 3:00 - 3:15 **Mathematics Education** **Room: 213**

Shayla Hoffman *Tarleton State University*

Courtney Holland *Tarleton State University*

Both lecturing and interaction play a large part in mathematics classroom. Learn and experience how to incorporate engaging activities to deepen student understanding and generate formative data. Walk away with strategies you can incorporate instantly!

How mathematics has helped me in my career.

Time: 3:20 - 3:35 **Room: 208**

Kelly Francis *Cummings Aerospace*

Kelly Francis, Executive Vice President at Cummings Aerospace, reflects on how mathematics has impacted their career.

The Cubic Formula and Why We Don't Teach It

Time: 3:20 - 3:35 **Algebra and Number Theory** **Room: 209**

Andrew Jay Potter *Hardin-Simmons University*

Tartaglia developed (and Cardano published) a formula for solving cubic equations of the type: $x^3 + px = q$. I will give a generalization of the formula for equations of the type $ax^3 + bx^2 + cx + d = 0$ as well as examples of its use. It will be self-evident why we don't teach this formula in high school or college algebra courses.

Visualizing Eigenvalues and Eigenvectors

Time: 3:20 - 3:35 **Analysis** **Room: 212**

John Gresham *Tarleton State University*

Michael Warren *Tarleton State University*

Bryant Wyatt *Tarleton State University*

Eigenvalues and eigenvectors are learned in linear algebra as a rote procedure without context. Students are told they are important but are rarely given any visual representation as to the connection they have to their parent matrix. There has to be a better way to present this extremely important linear algebra concept to students. We will explore the behavior of linear dynamical systems and classify that behavior based on eigenvalues and eigenvectors. This exploration is accomplished with an interactive, visual computer application. The user is prompted with a choice of parameters and can explore the long-term behavior of the system. This allows for insight to be gained through repeated trials. This application is useful for teachers as well as students who are wanting a deeper conceptual understanding of eigenvalues and eigenvectors.

Math and Magic in College Courses

Time: 3:20 - 3:35 **Mathematics Education** **Room: 213**

Ricardo V Teixeira *University of Houston - Victoria*

Some mathematical concepts can be illustrated via magic tricks. In this talk, several ideas of including recreational mathematics in college level mathematics courses will be discussed. Magic tricks will also be taught, and books and journals titles will be listed for further interest.

Alarming Decrease in Math Majors

Time: 3:40 - 3:55 **Other** **Room: 208**

Tingxiu Wang *Texas A&M University-Commerce*

In this talk, the presenter shows the data of math majors at all 35 public universities in Texas from 2014-2021. The number of math majors drops significantly.

Semidisjoint Permutations

Time: 3:40 - 3:55 **Algebra and Number Theory** **Room: 209**

Richard Winton *Tarleton State University*

Fixed points and transient points are defined in the group Sym(S) of permutations on a nonempty set S. Disjoint and semidisjoint permutations are then defined in terms of transient points. It is shown that the collection of disjoint pairs of permutations in Sym(S) is (properly) contained in the collection of semidisjoint pairs of permutations in Sym(S). Two main commutativity results for semidisjoint permutations are established. A counterexample is provided to verify that these two results cannot be combined to produce a more general commutativity result for semidisjoint permutations which has already been established for disjoint permutations.

Infinitely Many Solutions of a Semilinear Equation

Time: 3:40 - 3:55 **Analysis** **Room: 212**

Joseph Iaia *University of North Texas*

We examine $L(u) + K(|x|)f(u) = 0$ where $L(u)$ is the Laplacian of u and the region is the exterior of the ball of radius R. In addition, $f(u)$ $u^{-q} + u^p$ with $0 < q < 1 < p$, $K(|x|)$ $|x|^{-a}$ with $a > 0$, and $u(x) = 0$ for $|x| = R$. We search for solutions that go to zero as $|x|$ goes to infinity. We prove existence of an infinite number of solutions.

MY Math Apps Calculus

Time: 3:40 - 3:55 **Mathematics Education** **Room: 213**

Philip Yasskin *Texas A&M University*

MYMathApps Calculus is an online text for a 3 semester calculus course. You can see a sample of about half the chapters at https://mymathapps.com/mymacalc-sample/ I will show the structure of the text with emphasis on the interactivity. Graphics, both 2D and 3D, static and animated, visual and interactive, have been made with Maple and Three.js. The use of plots and animated plots helps students understand concepts such as: Calculus 1: definitions of a derivative as the limit of slopes of secant lines, linear approximation, derivatives of inverse functions, related rates, max/min problems, graphs of functions, triangle inequality, Mean value theorem. Calculus 2: Riemann sums, arc length, surface area, volumes by slicing and revolution, work, mixing problems, geometric series, convergence of Taylor series. Calculus 3: graphs and contour plots, polar curves, parametric curves and surfaces, partial derivatives as slopes of traces, directional derivatives, divergence and curl, Lagrange multipliers, expansion and circulation, multiple integrals, curvilinear coordinates and Jacobians, line and surface integrals, orientation issues in Green's, Stokes' and Gauss' theorems. The book also has lots of proofs and theory for interested students: precise limits with proofs of all the limit laws, Mean value theorem, derivation of formulas for applications of integrals, Taylor convergence theorem, velocity is tangent to curve.

The Turn of Some Friendly Cards and other Math Magic Tricks and Puzzles

Time: 4:00 - 4:15 **Mathematics Art** **Room: 208**

Kris Jorgenson *Sul Ross State University*

Some math magic tricks and puzzles have a hidden mathematical connection even though they appear externally to be different. We will perform a magic card trick with the help of a volunteer, and then examine why this trick works. Then we will relate this math principle to other math puzzles at least one of which could be performed as a magic trick.

College Algebra Proof of FTA

Time: 4:00 - 4:15 **Algebra and Number Theory** **Room: 209**

Franklin Kemp *(Co)Sine Clock Company*

We apply William Kingdon Clifford's FTA Proofs of quadratic factorization of even polynomials to quartic, sextic, and octic cases. These examples of the proof show that quadratic division, simple algebraic elimination of the variable x between two polynomial equations, determinant use, and the intermediate value theorem suffice to prove the FTA. We show that the algebraic eliminant is equivalent to the formidable sounding Sylvester's Dialytic method's determinant (a.k.a. resultant) enabling us to use the elegant compact Sylvester's determinant on our cases; thereby, avoiding laborious steps of algebraic elimination.

CAM Cans - Computer Aided Mathematics and Packing Right Circular Cylinders

Time: 4:00 - 4:15 **Mathematics Education** **Room: 212**

Peter White *Tarleton State University*

Bowen Brawner *Tarleton State University*

In Multivariate Calculus, the concept of Lagrange Multipliers can be used to easily find the dimensions of a right circular cylinder (can) of fixed volume with minimal surface area. In this exploration, Mathematica is used to find the dimensions of cans of fixed volume with minimal cost function, where the cost is the sum of the cost of the surface area of multiple cans and the cost of the surface area of the rectangular box that the cans are packaged in. Several arrangements of the cans and various relative cost functions are examined with an emphasis placed on how to use Mathematica as a teaching aid in applications of Lagrange Multipliers.

Standardization in Multi-Section Mathematics Courses

Time: 4:00 - 4:15 **Mathematics Education** **Room: 213**

Beth Riggs *Tarleton State University*

This session will describe our model for standardizing several of our multi-section courses within the Mathematics Department at Tarleton State University. From syllabi to pacing calendars to departmentalized testing processes, we will share our lessons learned along the journey to cultivate a consistent experience for students across sections while incorporating faculty input and upholding course standards and academic integrity.

Notes

Index