Abstracts of Invited Speakers and Short Course

(Chronological order)

Short Course

Ted Mahavier & Jacqueline Jensen-Vallin, Lamar University

This active-learning, participant-centered workshop will focus on the key elements needed to begin development of an IBL course. These include securing the necessary time and administrative support early; deciding between selecting material or developing material for the content; developing a grading plan and syllabus; and plans for creating a successful classroom culture. Short working sessions on each topic will help the facilitators guide you to your first successful implementation of an IBL course!

Student Forum - The Mathematics of Hank in Finding Dory

Kevin Singleton, Pixar Animation Studios, Inc.

The fluid motion of the arm of an octopus presented new problems for Pixar Animation Studios, Inc. in the making of Finding Dory. Singleton was part of the team who found the solution to the problem and will be presenting those breakthroughs in computer programming and animation.

Opening Address - Combinatorial Fixed Point Theorems

Francis Su, Harvey Mudd College

Sperner's Lemma is a combinatorial analog of a famous theorem in topology: the Brouwer fixed point theorem. In this talk, I will trace recent connections, generalizations, and applications of Sperner's lemma to the Nash equilibrium theorem, problem of fair division, and the game of Hex.

Math Circle Demonstration

Jane Long, Stephen F. Austin University

Math Circles are groups that give K-12 students or math teachers the opportunity to investigate mathematical problems that can be stated simply but lead to deep and substantial mathematics, allowing them to enhance their problem-solving skills. There are over 180 active Math Circles in the US, including many in Texas. Join us for a demonstration of a Math Circle session and a brief question-and-answer period.

Some Things I Didnt Learn From the Texas Section

Stuart Anderson, Texas A&M University-Commerce

This non-technical talk will blend reminiscing and a review of events in the MAA and the Texas Section. The aim is to show the value of participation in MAA activities in particular, the Texas Section.

Design Research to Enhance Coherence, Rigor, and Accessibility in Calculus Instruction

Mike Oehrtman, Oklahoma State University

Limits are at the core of the introductory calculus curriculum in the sense that the majority of important concepts are formally defined in terms of limits. Unfortunately, limit concepts are also notoriously difficult for students, and decades of research has revealed numerous misconceptions and barriers to conceptual understanding. Project CLEAR Calculus has engaged in design research to address the false dichotomy between a formally sound, structurally robust treatment of calculus on the one hand and a conceptually accessible and applicable approach on the other. In this talk, I will define and discuss implications of approaches to calculus that stress formal definition and proof or that provide compelling intuitive imagery to circumvent such formalism. I will then describe initial phases of the CLEAR Calculus research that identified ideas about approximation and error analyses as a productive conceptual foundation for teaching calculus and differential equations. Finally, I will cover the subsequent iterative refinement of instructional activities that scaffold development of student understanding and their impact on student learning and faculty instruction.

What is Mathematical Creativity in Proving and How Can it be Fostered?

Milos Savich, University of Oklahoma

The year is 2016 and the landscape of mathematics education is changing. There is Wolfram Alpha, capable of computing double integrals from a cell phone; Chegg which has step-by-step solutions for major textbooks; and whole research fields dedicated to automatic theorem-proving. Therefore, according to the MAA Committee for Undergrad Math Programs (2015), focus in pedagogy may need to be on other humanistic aspects of mathematics. Our research group is interested in one that has been cited as important to prominent mathematicians (Borwein, Liljedahl, & Zhai, 2014): mathematical creativity. Pioneering the somewhat small field of creativity in undergraduate mathematics, we have created a rubric, the Creativity-in-Progress Rubric (CPR) on Proving, that can be explicitly used by students and instructors as a formative assessment tool. Details of the construction and how the CPR on Proving was used will be presented, as well as future research involving neuroscience methods to capture moments of mathematical creativity.

Fruitful Fallacies

Harold Boas, Texas A&M University, College Station

The path to Mathematical Truth is indirect. The route meanders through Conjecture Canyon, Goof Gully, and Misconception Mesa. To fully appreciate the arrival at Truth requires a visit to Error on the way. This guided historical tour, suitable for all ages, includes interesting detours along the scenic trail to Proof Peak.

Abstracts of Contributed Talks

(Ordered by the last name of presenter)

The impact of a natural language interface on novice CAS users: Wolfram-Alpha compared to commercial software

Reza O. Abbasian & John T. Sieben, Texas Lutheran University

In this presentation, we will explore the popular online computational knowledge engine Wolfram Alpha. Specifically, we will compare and contrast its capabilities with the commercial math software Maple. Using specific examples from pre-and post-calculus topics, we will demonstrate its advantages and its shortcomings in terms of the syntax, ease of use and accuracy of the results. Our focus in this talk is on using these tools from the viewpoint of a novice user on typical topics covered in undergraduate math and statistics courses. Our presentation is intended for mathematics and/or statistics educators with interest in using CAS and web resources in their classroom teaching.

Why Math? A perspective from Applied Calculus students

Luis Aguirre, Texas Christian University

One question that comes up often when teaching non STEM majors is why do we have to do this? Why do we care? This is a question I have been asked since I started tutoring as an undergraduate student. I have asked my Applied Calculus students to write an essay exploring why math is important to their major. Furthermore, I also asked to either answer the question What is math?, or how their perspective of math has changed from elementary school to college. This talk will focus on the more insightful responses, as well as analyzing the more nave ones. A list of common themes will be presented and analyzed.

Applications of Graph Theory in the Soccer Field

Alan Amaya, University of the Incarnate Word

Soccer is the most popular sport, worldwide. Many different data is recorded in order to analyze the game at a deeper level. This data includes number of goals, percentage of ball possession, and number of passes. Although this data does share much information regarding the game, it is argued that it is very superficial. In order to study deeper patterns of soccer, and identify key players of a team, graph theoretic methods will be applied. By treating each player from the team as a node, and the passes amongst the team as an edge, we will be able to treat a team as a graph, and use graph domination and graph coloring to determine the fluidity of a teams playing style, and predict its success in the league.

KLR Algebras in Sage

Mary Barker, Tarleton State University

Since their introduction in 2008, KLR algebras have spurred an incredible amount of research, owing to their deep connections to many different areas of math and physics. Though they have a beautiful diagrammatic presentation, computing with KLR algebras often involves extensive calculations which are time-intensive and convoluted to do by hand. We are developing a KLR algebra package in SageMath as a means of calculating and even visualizing these complex structures, opening the door for further explorations into KLR algebras in general. Some further extensions to this package are also presented, including the development of an efficient implementation of quantum shuffle algebras, which we use to compute transition matrices between certain important bases of quantum groups.

Relating proofs and revisions: A case study of an inquiry-based college geometry course

Janessa Beach & Rebecca Dibbs, Texas A&M University-Commerce

Research indicates that teachers are not proficient in proof. Since geometry is secondary students only exposure to proof, it is important our secondary teachers can prove effectively in this content area. College geometry is understudied, so this project sought to determine to what extent pre-service teachers proof schemes became more axiomatic throughout an IBL geometry course.

STEM Major Mindset Changes During Their First Undergraduate Mathematics Course

Laura Beene & Rebecca Dibbs, Texas A&M University-Commerce

One of the reasons for the exodus in STEM majors is students experiences in their first undergraduate mathematics course, usually introductory calculus. However, students with a growth mindset are more likely to persist past these initial courses. Although there is evidence that curricula like CLEAR calculus promoted gains in students growth mindset, it is unclear how this curriculum compares to traditionally. The purpose of this quasi-experimental study was to investigate to what extent students enroll in CLEAR calculus become more growth mindset orientated than those that are enrolled in traditionally taught courses. The Patterns of Adaptive Learning Scale was used to measure the mindset of students in five sections of traditionally taught calculus and one section of CLEAR calculus. While there were not significant differences in the mindset changes between traditionally taught and CLEAR Calculus students, the power analysis indicated a larger sample size was required.

Theorycrafting: The Hidden Mathematical Analysis of Optimal Play in Massively Multiplayer Games.

Tera Benoit, Lamar University

Theorycrafting is the colloquial term for community driven mathematical analysis of the various systems of player performance in massively multiplayer role playing online games (MMORPGs). Players use a process called datamining to recover hidden numbers and coefficients from game files. They then use this information in tandem with testing and simulation to develop formulas that are used to inform mathematically optimal player performance. This research is to develop an overarching analysis of the various ways in which these communities collect and parse their data in an effort to understand how the interaction of developer design vs. player behavior has and will continue to influence the development of mathematical design philosophy in the ever-evolving gameplay systems of MMORPGs.

Improvements in ELPAC Segmentation and Applications

Adam Bowden, Richard Selvaggi & Nikolay Sirakov, Texas A&M University-Commerce

We present the continuation in the developments of the Euler-Lagrange-Poisson Active Contour (ELPAC) image segmentation. Original developments involved the segmentation of image objects by a contour moved by the solution to the Euler-Lagrange equation through a vector field generated by the solution of a specific form of the Poisson equation. Further developments implemented the line integral into the method in order to check conditions along the detected edge. Presently, a splitting scheme has be added to segment multiple objects in an image.

Lessons From Darwin: Using a Genetic Algorithm to Optimize Structural Stability

Joseph Brown, Tarleton State University

In order to apply a genetic algorithm to structures composed of steel beams, we have constructed a model for how the structure changes over time under external forces. The model treats these steel beams as ideal springs with limits at which they are considered to have failed under tensile or compressive forces. By modeling structures in this way, stable collections of beams can be selected to better withstand external forces, reach higher, and remain lighter. We have applied a genetic algorithm to this state space to optimize these qualities. Because of the large number of calculations and the need for multiple trials to determine success, we used parallel processing on graphics cards to run the models. With fast algorithms available for optimizing valuable features, we can design these structures more effectively in the future.

Understanding Community College Math Faculty Perceptions and Implementation of Cooperative Learning

Adam J. Castillo, The University of Texas at Austin

Cooperative learning, students working together in small groups to increase their own and each others learning, is a well-documented pedagogical approach to promote student learning. However, despite ample research on cooperative learning, there is little research on its use in community college math courses. This talk will highlight a pilot study on community college math faculty at four Texas community colleges involved in major math reform initiatives. The purpose of the study was to examine community college math faculty perceptions of cooperative learning and how it is used in developmental- and college-level math courses. The process for testing and modifying research instruments for future research on math faculty at different colleges will also be discussed.

Integration by Method of Undetermined Coefficients

Madyson Chance & Mike Panahi, Tarleton State University

There are many integration problems that are straight forward to evaluate, but are algebraically (and computationally) difficult to compute. In this presentation we are going to show a technique on how to use simple operations of differentiation, and fundamental theorem of calculus in order to do more difficult operations of integration with undetermined coefficients. The purpose of this presentation is to show that our technique of finding a template for many instances and can be used in place of harder integrations, such integration by parts.

Associating Geometry to $\mathcal{U}_q(\mathfrak{sl}_2)$

Richard Chandler & Michaela Vancliff, University of North Texas at Dallas

The algebra $\mathcal{U}_q(\mathfrak{sl}_2)$ is considered a quantum analog of the universal enveloping algebra of the Lie algebra $\mathfrak{sl}_2$. In this talk, we will consider a certain graded algebra $\mathcal{H}_q(\mathfrak{sl}_2)$, associated to $\mathcal{U}_q(\mathfrak{sl}_2)$, and study $\mathcal{H}_q(\mathfrak{sl}_2)$ via geometric techniques in the spirit of Artin, Tate and Van den Bergh. In particular, we will discuss the point scheme and the line scheme of $\mathcal{H}_q(\mathfrak{sl}_2)$ and relate them back to $\mathcal{U}_q(\mathfrak{sl}_2)$, including recognizing the quantum Casimir element as a distinguished element of $\mathcal{U}_q(\mathfrak{sl}_2)$.

Linking Math and English through The Martian

Sarah Cobb, Midwestern State University

In developing interdisciplinary learning opportunities for students, mathematics and writing might not seem like the most natural pairing. One way to link these subjects is through the study of science fiction. This talk will explore some of the mathematical ideas in The Martian by Andy Weir as well as giving examples of how those ideas were used to introduce mathematical elements to a freshman-level English composition course, creating a unique interdisciplinary experience for the students.

No-Slip Billiards

Scott Cook, Tarleton State University

The field of billiard dynamical systems studies mathematical properties of particles confined inside a chamber. The collision laws governing particle-surface and particle-particle interactions play central roles; the most widely studied law is specular collision (angle in = angle out). In 1992, Broomhead and Gutkin introduced a different collision law that allows transfer of momentum between translational and rotational motion of hard spheres which conserves total energy. Moreover, this new no-slip law does not involve force at a distance nor deformation of the particles during collision. In essence, this no-slip law brings friction-like properties into conservative, hard sphere interactions. In this talk, we will introduce the no-slip law and discuss ongoing simulation work into the stability and diffusion properties of many-particle, no-slip billiard systems.

Multiple analogues of binomial and Poisson distributions on the set of integer partitions

Hasan Coskun, Texas A&M University - Commerce

We introduce higher dimensional analogues of the binomial and Poisson density functions on the set of integer partitions in terms of the rational Macdonald functions.

Tessellations

Tracy E. Desrochers, Hardin-Simmons University

In this presentation, I will define regular, semi-regular, and irregular tessellations and give examples of these. I will look at the work of M.C. Escher and illustrate how to make a simple tessellation through a guided activity, which can be used in any middle school mathematics course.

Algebra I Interventions: A metasynthesis

Rebecca Dibbs, Brittany Hott, Campbell Reid, Cameron Carter, Meghann Holt, Taylor Kline, & Daniel Rios, Texas A&M University-Commerce

Children in rural settings are less likely to have access to quality math courses and perform significantly lower than their suburban counterparts. Fewer students from rural districts demonstrated mastery in Pre-Calculus/Advanced Placement (AP) courses with 7% of low-income students demonstrating mastery of these courses thus significantly decreasing access to higher-level mathematics, admission to college, and entry into STEM majors. However, there has been little systematic analysis of the qualitative research on successful interventions in Algebra I. The purpose of this meta-synthesis was to categorize the qualitative research algebra interventions in special education and mathematics education using meta-grounded theory. This talk will discuss the methodology and preliminary findings from the initial analysis.

Least and Biggest Topological Properties

Charles Dorsett, Texas A&M University-Commerce

There is a known properties weaker than T_1, which together with T_0, equals T_1. Is there a least such property? This question and other related questions will be given and resolved in this talk.

Sync and Swim: A Particle Model of the Interactions within Fish Schools

David Ebert & Mikaela Jordan, Tarleton State University

Animal aggregates are groupings of coupled animals that behave in a synchronized manner, such as flocks, herds, schools, and swarms. Flocks and schools are particularly interesting because the synchronization is not due to a leader. Instead, each animal in the aggregate follows instinctual "rules" about movement in relationship with each other and external animals and objects. We model the movement of a school of fish using Hooke's law and attraction-repulsion forces between fish and objects not in the school, including predators and prey. Leveraging parallel processing on graphics cards, we created an algorithm in C that simulates the movement and synchronization of schools of fish.

On the number of distinct balanced bipartite directed graphs with every node of outdegree 1

Julia Eilers, Baylor University

We consider balanced bipartite directed graphs with the property that every node has exactly one outgoing link. We are interested in the number of such graphs that are distinct under graph isomorphism. Such graphs will be shown to have application to the Stable Marriage (SM) Problem, since they can represent the first choice of each person. We are particularly interested in those graphs that contain no reciprocal links, that is, where link(link(A)) = A. Such reciprocal links are associated with instances of the SM Problem with relatively few stable matchings. For order 5, we can find a SM instance with a high number of stable matchings by first finding a promising graph representing just the first choices, and then filling out the remaining preferences in all possible ways.

Buffon's Needle

Keith E Emmert, Tarleton State University

The classic Buffon's Needle problem involves dropping a needle on an plane covered by uniformly spaced parallel lines. The problem is determining the probability of crossing a line (which involves π). This, and other extensions (both new and old) to the problem, will be discussed.

Guidance for Mathematicians Teaching Preservice Secondary Mathematics Teachers

James A. Mendoza Epperson, Kathryn Rhoads, & Theresa Jorgensen, The University of Texas at Arlington

Mathematics education research findings assert that future secondary mathematics teachers must learn the specialized knowledge for teaching mathematics (MKT), connect advanced mathematics topics to school mathematics, and engage in inquiry-based learning. We will discuss this in the context of the goals of the NSF-funded (DUE #1612380) Enhancing Explorations in Functions for Preservice Secondary Mathematics Teachers project at UT-Arlington which is working to create and enhance research-based explorations for use in targeted mathematics courses for secondary mathematics teachers such as the well-known UTeach Functions and Modeling course. We highlight our preliminary work and include an example exploration that illustrates an inquiry-based approach to addressing this MKT and connections between advanced mathematics and school mathematics. We explore possible pedagogical needs and other issues for mathematicians teaching future secondary mathematics teachers as it relates to this work.

Heliocentric Lunar Formation Simulation

Aser Garcia & Eric Scott Hall, Tarleton State University

This project aims to incorporate the effects of the Sun on lunar forming impact simulations. Data results of the proto-earth collision research at Tarleton State University achieved correct angular momentum and other astronomic values that reflected real world phenomena. The next point of interest was to investigate the force of the Sun on the lunar impact. A simulation was made with two proto-earths in order to study affects the Sun could have on the collision. Data from NASA's Horizons system at JPL and the initial conditions from previous simulations conducted by Tarleton students were used to seed the simulation. The forces were approximated with Newtons inverse square law and the leap frog method as the numerical integrator. The simulation was then run in reverse in order to discover where the bodies started in relation to our sun.

On the denesting of nested square roots

Eleftherios Gkioulekas, University of Texas- Rio Grande Valley

We present the basic theory of denesting nested square roots, from an elementary point of view, suitable for lower-level coursework. Necessary and sufficient conditions are given for direct denesting, where the nested expression is rewritten as a sum of square roots of rational numbers, and for indirect denesting, where the nested expression is rewritten as a sum of fourth-order roots of rational numbers. The theory is illustrated with several solved examples.

Integration by linear combination

Fred Halpern, Royal Path to Math

We develop the technique of integration by linear combination which is useful in dealing with integrals involving quasi-exponential functions like $e^x, \sin x$, and $\sinh x$. We are motivated by a theorem of Pease which summarizes the results of iterated integration by parts computations to provide a simple formula for computing integrals like $\int e^x \sin x\, dx$ and $\int \sin 2x \cos 3x\, dx$. Our main result generalizes Peases formula to integrals of arbitrary products of quasi-exponential functions like $\int xe^x \sin 2x \cos 3x\, dx$. A new proof of Peases formula is derived by an integration by guessing technique, the simplest instance of integration by linear combination.

Mathematical Models of Self-Assembly

Richard Harvel & Bobby Lindsey, Tarleton State University

Self-assembly is the spontaneous and reversible organization of units into ordered clusters. The study of self-assembly is important because the arrangement of units into a cluster can greatly affect the properties of that cluster; for instance, a particular arrangement of molecules may alter the thermodynamic properties of a material or improve the rate of binding to specific receptors within the body. Previously, observation of these clusters required time-consuming physical experimentation and processes such as lithography. Using mathematical models and the speed of parallel processing, we are able to reproduce the assembly of particles, rapidly generating millions of clusters. We present here how to generate these computer-modeled clusters and show how they can be rapidly cataloged and measured to gain insight into the complex processes of self-assembly.

Solving Systems of Differential Equations Using Gradient Descent Under the Sobolev Norm

Jason A. Hatton, Lamar University

While euclidean gradient descent can provide solutions to systems of differential equations, the use of the Sobolev norm in place of the Euclidean norm while calculating the gradient can greatly increase the reliability and rate of solving these systems. We shall solve a variety of systems of differential equations with boundary conditions using gradient descent under these two norms to demonstrate the benefits of the Sobolev norm. We first discretize our continuous differential equations using our defined linear transformations D_0 and D_1. From this we have a function $f : \mathbb{R}^n -> \mathbb{R}$. We then define $\phi(f(u)) = \frac{1}{2}\|f(u)\|^2$ and minimize ϕ by performing gradient descent. A vector u such that $\phi(f(u)) = 0$ grants us a solution to our system. Further optimizations involving step size, efficient storage of D_0 and D_1, and linearization of non-linear systems are also discussed.

Optimizing Batting Order: A Markov Chain Approach
Nathanael Hellerman, Texas Christian University

Batting order is a frequently debated topic for any baseball team. Markov Chains can be used to model the productivity of any given line-up. The results are compared with traditional batting order strategies

Numbers
Jordan L. Hess, University of Texas at Dallas

Infinity says to her sister, I just dont get it. How is it that they deny me yet accept you with open arms. Do they not see that to accept you and deny me is to deny themselves? For they necessarily ARE me with respect to you. Self-righteous fools those Natural numbers are. Careful she replies - To accept you is to become me, and that is an empty feeling indeed.

Using Graph Theory to Eliminte Discontinuity in Minecraft's Procedural Biome Generation
Jonathan Hodges, Lamar University

Procedural Content Generation (PCG) is a form of content generation used in video games in which certain aspects, such as the environment, are generated as the player explores without any extra input from the developers. The video game Minecraft uses PCG in most of the games applications. However, Minecrafts procedural biome generation is flawed, which may lead to immersion breaking discontinuity, such as going from a tundra to a rain forest. In Graph Theory, we take a set of vertices, V, and the set of corresponding edges between those vertices, E, to make a graph. We believe that graph theory can be used as a checking tool for biome transitions in Minecraft. Our goal is to create a more realistic experience when transitioning from one biome to another when PCG is utilized in Minecrafts biome generation.

Hilbert's 23 **Problems**
Kourtney Holyfield, Hardin-Simmons University

In this project, we will look into the 23 problems that Hilbert proposed should be solved by this century. Not all of them are solved and we will look at some of those problems to see why they havent been solved. We will also look into the problems that have been solved and see how they were solved as well as compare them to other things we know. Some of the things we will look at are the various postulates used, axioms, and types of geometry.

Houston We Have A Problem: East Texas Mathematics Teacher Professional Development Needs
Brittany Hott, Rebecca Dibbs, Daniel Rios, Campbell Reid, & Cameron Carter, Texas A&M University -Commerce

Mathematics problems are well documented in the United States. These problems are often compounded for students who attend rural districts. This session reports the results of a comprehensive needs assessment conducted with east Texas Algebra teachers. Findings suggest that teachers are in need of additional training in evidence-based intervention practices, particularly for students with mathematics difficulty or disability. Implications for practice and future research directions are provided.

The Perfect Free Throw
Will Howard, Hardin-Simmons University

I will be discussing Dirk Nowitzkis free throw percentage and how he could improve it based on release angle, launch speed, and amount of backspin applied.

College Algebra Flipped: Comparative results from 1000 **students**
Keith Hubbard & Beth Coiry, Stephen F. Austin State, Sam Houston State

We designed flipped College Algebra materials then tracked implementation between flipped and standard sections over two semesters. In total 16 traditional and 16 flipped sections were examined for student success, student persistence, and instructor perceptions.

Cultivating Research Opportunities for Students through NSF S-STEM
Timothy Huber, University of Texas Rio Grande Valley

Second year efforts to promote student research through a National Science Foundation funded S-STEM program will be discussed. The activities build on a multifaceted mentoring and academic support structure put in place during the first year. Second year efforts emphasize research experiences and early exposure to proof-based mathematics to aid the transition to upper level mathematics courses.

Observations on Convexity of Sets
Chad Huckaby, Stephen F. Austin State University

A common topic in mathematics is the idea of geometric convexity. An alternate definition of convexity is convexity with respect to a set of analytic functions. If a set A is compact in C, then the geometric linear convex hull of A is equal to the functional linear convex hull. The goal of the presentation is to show one containment of the proof of the result above.

Got Gas? Sequestration of Carbon Particles Using Parallelized Simulations of No-slip Gas Dynamics in a Thermophoretic Environment

Taylor Hutyra & Mary Barker, Tarleton State University

With the universal acceptance of global warming in the academic community, minimizing fossil fuel emissions has been a global effort. To isolate and remove large pollutants before emergence as gaseous emissions, we are developing a better model for predicting gas-surface behavior in a thermophoretic environment. This simulation allows us to validate mathematical models under development and promote the research by providing simulated experimental data that surpasses the current mathematical results. This new theory of temperature-induced particle movement (thermophoresis) is based on Random Billiard Dynamical Systems (RBDS). Previously, we expanded on this single particle model to accommodate N-bodies, which are necessary for more complex interactions required to model thermophoretic effects. Currently, the traditional elastic collision model has been modified to incorporate angular-momentum conserving (i.e. no-slip) collisions. This has allowed us to investigate diffusion effects of more physically complex interactions.

U.S. Presidents and Mathematics

Joseph Iaia, University of North Texas

We will discuss United States Presidents and their mathematical backgrounds including James A. Garfield's proof of the Pythagorean theorem, Ulysses S. Grant's ambitions to be a mathematics professor, Thomas Jefferson's wheel cipher, some other mathematical facts about U.S. Presidents, and a few honorable mentions.

Instruments in Ones and Zeros: How Computers Mimic Timbre

Amy Jenkins, Southwestern University

I aim to identify the mathematical characteristics that make instruments sound different to the ear, and how a computer uses the recorded samples in order to replicate not only the note, but the instrument recorded. My research will focus on three instruments: the violin, representing string instruments, the flute, representing wind instruments, and the human voice.

The Role of Self-Reflection in Math Courses

Jacqueline Jensen-Vallin, Lamar University

As mathematics educators, we agree that student success would be improved if students would look back at homework, reflect on comments, and implement suggested improvements in future submissions. To encourage students to implement some self-reflection in courses, part of the student grade in my courses is to submit a weekly reflection paper. This paper is supposed to summarize what was covered in the previous week, draw connections to material that came before, and ask questions they haven't yet answered. As the semester proceeds, these submissions read less like a book report and more like a reflection paper. We will discuss these assignments and provide some examples.

Existence and Non existence of solutions for sublinear problems with prescribed number of zeros on Exterior domains.

Janak Joshi, University of North Texas

We Prove existence of radial solutions of $\Delta u + K(r)f(u) = 0$ on the exterior of the ball of radius $R > 0$ centered at the origin in $\mathbb{R}^N$ such that $\lim_{r\to\infty} u(r) = 0$ if $R > 0$ is sufficiently small. We assume $f : \mathbb{R} \to \mathbb{R}$ is odd and there exists $\beta > 0$ with $f < 0$ on $(0, \beta)$, $f > 0$ on (β, ∞) with f sublinear for large u and $K(r)$ $r^{-}\alpha$ for large r with $\alpha > 2(N-1)$. We also prove the nonexistence if $R > 0$ is sufficiently large.

Direct $D(t)$ computation from FRAP data reveals various anomalous diffusion types

Minchul Kang, Texas A&M University-Commerce

Due to complex cellular environments, biological diffusion is often correlated over time and described by a time dependent diffusion coefficient, $D(t)$. Although $D(t)$ potentially provided important information of cellular structures and proteins' transporting mechanisms, currently straightforward approaches to quantify $D(t)$ are lacking. Here, we develop a mathematical and theoretical framework to measure diffusion coefficients from individual FRAP data points. Using this approach, we detect various types of anomalous diffusion from various model proteins and lipid probes in cell membranes.

Reflection, calibration, and achievement in introductory calculus

Taylor Kline & Rebecca Dibbs, Texas A&M University-Commerce

One of the reasons for the exodus in STEM majors is students experiences in their first undergraduate mathematics course, usually introductory calculus. However, students with high calibration are more likely to be aware of their deficiencies and seek assistance in time for it to be effective. Although there is evidence that students who regularly complete post class reflections are more successful than those that do not, it is not known if such assignment also improves students calibration. The purpose of this correlational study was to investigate to what extent students enroll in CLEAR calculus become more growth mindset orientated the relationship between post-class reflections, calibration, and achievement in introductory calculus.

Absence seizures resulting from disharmonious dialogue between cortical neurons and astrocytes: A computational study

Suyu Liu & Jianzhong Su, University of Texas at Arlington

It is well known that astrocytes play supportive roles in synaptic transmission and neuronal excitability in the mammalian central nervous system. Meanwhile, accumulating evidence highlights the reciprocal dialogue of mutual cortical neuron-astrocyte calcium signaling, and its involvement in synchronizing neuronal network. And its disharmony can result in some neurological disorders such as epilepsy and schizophrenia. Nevertheless, how this disharmonious dialogue relates to the generation and development of absence seizures is not quite clear.

In this paper, we establish a computational framework of corticothalamic circuits to investigate the effect of the disharmonious dialogue on the occurrence of 2-4Hz spikes and slow wave discharges of cortical neurons. By using bifurcation analysis, we explore the disharmonious dialogue dynamics of calcium signaling in the transitional process of absence seizures. Results show that two transition routes of seizure-free state and absence seizure state occur as the bidirectional signaling strengths change in this proposed model. In addition, mutual modulations of these bidirectional signaling pathways are further studied to analyze the potential risk factors of absence seizures, which verifies the hypothesis that abnormal dialogue elicits absence seizures. Hopefully, the results we obtain could be helpful for effective control of seizures with additional drug intervention.

On Low Rank Approximation of Linear Operators

Yang Liu, Sun Yat-sen University

In this talk, we study the optimal or best approximation of any linear operator by low rank linear operators, especially, any linear operator on the p-space, $p \in [1,)$, under p norm, or in Minkowski distance. Considering generalized singular values and using techniques from differential geometry, we extend the classical SchmidtMirsky theorem in the direction of the p-norm of linear operators for some p values. Also, we develop and provide algorithms for finding the solution to the low rank approximation problems in some nontrivial scenarios. The results can be applied to, in particular, matrix completion and sparse matrix recovery.

One Model for a Capstone Course for Mathematics Majors

Jane Long, Stephen F. Austin State University

For the past three years, Stephen F. Austin State University has run a 1-hour, required capstone course focusing on problem solving for its mathematics majors. Goals, sample activities, and organizational aspects of this successful course will be discussed.

American Roulette: How Long Can You Play?

Amira Mahler, St. Edward's University

American Roulette is a casino game in which players place various types of bets on sets of numbers. A wheel is then spun to determine the winning number; players who bet on this number win their bet amount plus a payout multiplier specific to each type of bet while players who did not lose their bet amount. Previous research uses Markov chains to compute probabilities of players accumulating a desired amount of money ("success") or losing all their money ("ruin") under various betting strategies. We use Markov chains to compute the expected game lengths until success or ruin under similar betting strategies and then explore more dynamic betting strategies.

Static and Steady-State Bubbles in the Channel

Jacob Makaya, Texas A&M International University

Consider the 2dimension selection-problem of static bubbles in a horizontal channel. The channel is filled with incompressible viscous fluid. Fluid of different viscosity is pumped in one end of the channel. The less viscous fluid drives the more viscous one creating bubbles. For a finite number of bubbles, we use conformal mappings and reduction to symmetry to derive an explicit solution using Greens Function and Harmonic Measure.

Simulating a Benzene molecule using damped oscillators

Kassie Marble &J. T Florence, Tarleton State University

Carbon-carbon bonds are the foundation of organic chemistry, with Benzene being the most important stable organic molecule. A large variety of more complicated organic compounds can be formed by replacing one or more of Benzenes hydrogens with a functional group. For example, Cephalexin a compound used to treat bacterial infections, is derived from Benzene. We numerically simulated a Benzene ring using classically damped oscillators to model its inter-atomic bonds. This molecular dynamics simulation will allow us to study properties of Benzene rings in a more in depth way than experimental work and serve as a starting point for future projects to analyze a variety of more complicated organic molecules.

The Divine Ratio: a re-visitation of its majesty

Talon McCallam, El Centro College

The purpose of this presentation is a re-visitation of the magnificent essence of the Golden Ratio and take a deeper look in to the intrinsic properties of phi. Beginning with a description and short history of the Golden Ratio and its relation to the different cultures across the world, it will follow with a deeper look at the intrinsic properties of phi and look at its relationship with other mathematical concepts and theories. It will finish with a philosophical moral from the wisdom of the number phi.

An Exploration of Wilson's Theorem
Aaron McCoy, Lamar University

Wilsons theorem states that a natural number n is prime if and only if $(n-1)! \equiv -1(modn)$. This theorem is used in determining why the product of all positive, coprime numbers less than a number m is congruent to 1 or -1 (mod m). Upon further exploration of this problem, we will show that numbers m of multiple 4 that are not equal to 4 yield a congruence equal to 1 (mod m) and all other numbers yield a congruence equal to -1 (mod m).

On a class of few weight codes
Lauren Melcher & Pani Seneviratne, Texas A&M University-Commerce

Recently, there has been a growing interest in studying codes with 2 or 3 weights due to their applications in cryptography, strongly regular graphs, and association schemes. We construct a class of linear codes by puncturing two disjoint subspaces from F_q^n. We will show that these codes are self-orthogonal and satisfy the Griesmer bound.

Weingarten Surfaces from Integrable Partial Differential Equations
Sergio Melendez, University of the Incarnate Word

We analyze surfaces in three-dimensional Euclidean space associated with nonlinear partial differential equations, such as the modified Korteweg-de Vries and sine-Gordon equations. Using Syms formula, we compute the parametrization of the surfaces and calculate their properties such as the first and second fundamental forms. Through analysis of the Gaussian and mean curvature and plotting of the surfaces, we develop a better understanding of the surfaces. Some of these surfaces are classified as Weingarten surfaces.

On the spectrum: A single case study of students with autism in secondary mathematics
Ja'Bria Miles & Rebecca Dibbs, Texas A&M University-Commerce

More and more students are falling on the autism spectrum and teachers are not equipped to teach them. Autism spectrum disorder (ASD) and autism are both general terms for a group of complex disorders of brain development. These disorders are characterized, in varying degrees, by difficulties in social interaction, verbal and nonverbal communication and repetitive behaviors. This single case study will be conducted as a mathematics intervention for a student with autism. This research will not only help the student improve in math, it will also help mathematics teachers be more capable of teaching mathematics to students with autism. This presentation will outline the design of the study and preliminary results.

The Affect of Dice Probability on Player Experience in Tabletop Role-playing Games
Jason Miller, Lamar University

Many tabletop role-playing games, such as Dungeons & Dragons, rely on dice to introduce an element of chance to the game. Different game systems change the dice they use and their methods for measuring success. These differences change the frequency distribution of the dice rolls, which in turn changes the actions and reactions of the players. This research examines several game systems and their methods for determining player success and failure to see how the changes made to each game system affect the frequency distribution of dice rolls and the experience of the players. It compares the intended tone and experience of each game system to the actual likelihood of a given player's success or failure in order to determine how the underlying mathematics may impact subjective player experience.

Frequency and Amplitude for a Nonlinear Oscillator by Homotopy Analysis Method
Jonathan Mitchell, Stephen F. Austin State University

The Homotopy Analysis Method (HAM) has been shown to approximate solutions to nonlinear problems of various types. The method is useful because of the flexibility in defining the auxiliary parameter h and that no assumption concerning relative size of parameters is required. We use HAM to approximate frequency and amplitude of a conservative nonlinear oscillator which has many applications including lasers, epidemics, and microparasites. As an example, we will consider a nonlinear oscillator given by the second-order ordinary differential equation $u'' + u + uu' = 0$. We compare our results to those gained from traditional perturbation techniques and briefly discuss conditions for convergence.

Amortization schedules: Did the student cheat?
Montie Monzingo, Southern Methodist University

In my opinion, the most important lessons in math of finance are computing amortization schedules such as in the purchase of an automobile. When testing students on amortization problems, I only require one row of a typical amortization schedule; payment, interest, reduction of the balance, and the unpaid balance. While grading exams, I found a situation where it appeared that a student copied an answer, but simply placed it in the wrong slot. So, did the student cheat?

New Knot Invariants Relating the Alexander and Jones Polynomials
Alejandro Moran & Kathryn Van Dinh, Austin College - Exhibitor

Knots are 3-dimensional loops that do not intersect themselves. Often it is hard to determine if two knots are of the same. Polynomial knot invariants are used to determine if the two knots are in fact different. In this talk, we will describe new polynomial knot invariants that occur in the Melvin-Morton-Rozansky expansion of the colored Jones polynomial and their properties. This expansion is of particular interest as it provides a relationship between the Jones polynomial and the Alexander polynomial, two of the most well-known knot invariants. We will discuss how we calculated these polynomials and some of the challenges we faced.

Colored RSK Correspondence
Robert Muth, Tarleton State University

The Robinson-Schensted-Knuth (RSK) correspondence, proved in 1970, is a fascinating combinatorial algorithm which links matrices of non-negative integers to pairs of semistandard tableaux. This correspondence has meaningful implications in group theory, as it establishes a connection between certain bases which are important in the study of the general linear group. In this talk I will describe the classical RSK correspondence along with a 'colored' generalization which informs the study of bases for a much broader class of algebraic objects.

The Collatz Conjecture: An Undergraduate Approach
David Offner, Hardin-Simmons University

The Collatz Conjecture was posed by Lothar Collatz in 1937. It is a simple function for positive integers that has the statement that all positive integers will reach one in a finite number of iterations. I will give the entire definition for the conjecture made by Collatz, and explain my attempt at proving the conjecture with a pattern I noticed.

Probability in Baseball
Anthony Phillips, Stephen F. Austin State University

What truly separates an ace starting pitcher from a back end of the rotation starting pitcher? We will look at the effect a pitcher's OPS (On base Plus Slugging percentage) has on their ERA (Earned Run Average) and what increases your likelihood of being an ace starting pitcher. We will use the results found to look at starting pitchers who have a good chance of out proforming their results from 2016, and starting pitchers' teams should have signed or traded for, at a discounted rate to their true value.

Space Balls: Particle Modeling Solar System Formation
Janine Prukop & Lillian Saunders, Tarleton State University

Most scientists agree on the nebular hypothesis of solar system formation, stating that the solar system most likely formed from a giant cloud that collapsed in on itself, forming our sun and a protoplanetary disk that then formed the planets and other objects in our solar system. Since there is no way to physically model this phenomenon, scientists have to turn to mathematical models to obtain supporting evidence for this model. In order to overcome the challenges presented by the scale and complexity of this problem, we created a n-body computational model using parallel processing. This allows us to simulate the formation of the sun and gas giants to further support the nebular hypothesis.

How Precalculus Students Can Find the Decimal Expansions of Logarithms
John Quintanilla, University of North Texas

Scientific calculators typically use Taylor series to produce the decimal expansions of logarithms. In this talk, I show how to compute logarithms to nine or ten decimal places by instead creatively using the Laws of Logarithms. This technique arose from a Precalculus classroom demonstration, which will also be presented, that Ive used to deepen both students proficiency with the Laws of Logarithms as well as their basic numeracy with logarithms, such as estimating $\log_{10} 65,085$ without a calculator. Several of my former students, who are now secondary teachers, have successfully replicated this demonstration with their current students. Time permitting, Ill talk about how I responded (successfully) to a students challenge of estimating $\sqrt[19]{25,757}$ without a calculator.

Feel the pressure: Modeling dispersion of fuel particles inside an engine cylinder
Douglas Rowe & Parker Rider, Tarleton State University

Direct injection offers two main benefits over carburetors and multi-point fuel injection. Engines that employ direct injection allow higher proportion of air versus fuel in the cylinder, which leads to better fuel economy. Additionally, better dispersion of the gas inside the chamber allows it to burn more efficiently. The combination of the fuel ratio and dispersion also lead to cleaner emissions and better engine performance. With the power of parallel processing we model direct fuel injection into an engine cylinder. The goal of our research is to achieve a high dispersion of fuel particles which would lead to a cleaner combustion with increased power while minimizing fuel consumption.

Ice Ice Baby: Simulating the molecular interactions of water molecules and the formation of ice crystals

Michael Rubio & Pedro Romero, Tarleton State University

Water is one of the most important elements on Earth. As water freezes, the hydrogen atoms from one molecule bind to the oxygen atoms of other molecules with hydrogen bonds. Ice has the potential to exhibit up to sixteen different geometries depending on temperature and pressure. Most ice found on Earth, however, exhibits a hexagonal crystalline structure. We created a scalable numeric algorithm that simulates the atomic forces in order to evaluate the properties of water. This allows us to accurately model what freezing looks like at the molecular level. The scalability enables us to explore how individual atoms bond as well as large aggregates. Our model will provide insight on the structure of ice formation and help to explain phenomena based on this formation such as radiation reflectivity in glaciers and clouds.

Hero's Formula

Josh Schneider, Hardin-Simmons University

Hero of Alexandria, a Greek Engineer and Mathematician in 10-70 AD, is credited for developing a formula which can find the area of a triangle using the length of its three sides. This presentation will provide some insightful information about Hero, explore other versions of the formula throughout history, and illustrate some of its supporting proofs.

Properties and examples of Generalized Inverse Limits

Paul Schwartz, Lamar University

Suppose f is a set valued function from the unit closed interval to the set of all closed subsets of the unit closed interval. Then we can define the generalized inverse limit of f. We can also use some basic properties of the function to determine when the inverse limit is connected (or disconnected). We will also examine the inverse limits created by a family of functions.

Fostering Students Preparation and Achievement in in Upper Level Math Courses

Ali Shaqlaih & Mehmet Celik, University of North Texas at Dallas

A Hybrid Inquiry Based Learning (HIBL) strategy that was implemented in some upper level mathematics classes to motivate students to prepare for upper-level mathematics classes will be presented. The strategy increased motivation for class preparation which, in turn, fostered students in-and out-of-class interactions and boosts students self-confidence on studying math on their own. The efficiency of the strategy, the assessment methods and students achievement will be presented.

Examining Special Elements in Hypergraphs

Ashton Short, Angelo State Univeristy

In a connected k-polymatroid, at least two elements will leave the polymatroid connected when either deleted or contracted. What do these special elements, called non-essential elements, look like in k-polymatroids and their respective hypergraphs? This talk will investigate the 3-hypergraphs associated with 2-polymatroids that have exactly two non-essential elements. The result obtained will be a description of non-essential elements in hypergraphs and the characterization of all 3-hypergraphs with exactly two non-essential elements.

Tips for Awarding Partial Credit on Calculus Problems

Jeremy Smith, Texas Christian University

Figuring out how much partial credit to give (if any) for a wrong answer can be a real headache for most teachers. On many problems, there are a plethora of errors that can be made by the student, making them hard to foresee and compare from student to student. In this talk, we look at a few standard Calculus problems and offer some possible solutions in grading philosophy and problem structure that can make this task easier to handle.

Modeling the Early Stages of a Within-Host Viral Infection

Krystin E. Steelman & Linda J.S. Allen, Texas Tech University

Influenza, Ebola virus and Hantavirus are some of the many viral infections of major public health concern. Each virus replicates within specific target cells. Hantavirus replicates within the lung microvascular endothelial cells. A well-known target cell model for the early stage of infection is a system of ODEs which includes healthy target cells, latent cells, infected cells, and free viruses. The ODE model provides information about stages of infection and serves as a framework for new stochastic models. A continuous-time Markov chain model and includes variability in the birth, death, and transmission process. An estimate of the probability of a successful infection is obtained from a branching process approximation of the Markov chain. This estimate depends on the initial concentration of virions, latent cells, and infected cells. A sensitivity analysis for probability of infection with respect to model parameters is performed for an in vitro model of influenza infection.

Online Videos that Support Class Material

Rebecca Steward, Texas A&M University - Commerce

I make online videos that go with my test reviews for each mathematics course I teach. The videos may be used in many modalities such as face to face, web enhanced, hybrid, online, and blended classes. These videos allow my students another opportunity to watch how I present the material and what I am looking for on the test. The videos also assist students in understanding the material, which allows them to be more successful on the tests and in the class. I have them organized on my class website where the videos are linked through youtube.com, which allows my students to have easy access to the videos.

North Carolina and Pennsylvania for Boardwalk? Trade Values for Monopoly Real Estate

Crisel Suarez, St. Edward's University

The objective of the game Monopoly is to become the wealthiest player through buying, renting and trading properties. In order to improve a players chance of winning, a player can optimize their trading strategy. We present a project where we are able to model, simulate 10 million Monopoly games and collect data on the expected values of properties. For example, when two players are trading who would have a better deal? With the data collected we are able to determine the expected value for each property, compare other players properties and decide if they want to make the trade. Future works for this research include optimization of the model, trading properties for money and applications to analytics.

Creating an Isotopically Similar Earth-Moon System with Correct Angular Momentum from a Giant Impact

William Sumpter, Ty Turner & Edward Smith, Tarleton State University

The giant impact hypothesis is the dominant theory explaining the formation of our Moon. However, its inability to produce an isotopically similar Earth-Moon system with correct angular momentum has cast a shadow on its validity. Computer-generated impacts have been successful in producing virtual systems that possess many of the physical properties we observe. Yet, addressing the isotopic similarities between the Earth and Moon coupled with correct angular momentum has proven to be challenging. Equilibration and evection resonance have been put forth as a means of reconciling the models. However, both were rejected in a meeting at The Royal Society in London. The main concern was that models were multi-staged and too complex. Here, we present initial impact conditions that produce an Earth-Moon system whose angular momentum and isotopic properties are correct. The model is straightforward and the results are a natural consequence of the impact.

A Merry Gander at Gerrymandering

Adam Swayze, Joseph Brown & Mary Barker, Tarleton State University

In a startling ruling this month, federal judges voided three Texas districts on the grounds that the distribution unfairly diluted minority votes to diminish their representation. This result highlights the need for a metric that quantifies the fairness of a proposed district. With congressional and state redistricting approaching, this has become a pressing concern nationwide. While arguments can be made for and against given districts, we need a more concrete and well-defined method for evaluating these characteristics in a legal framework. Our contribution is to apply a Metropolis-Hastings algorithm with probabilities taken from a function space over metrics including compactness (geographic shape), compliance (Voting Rights Act), and efficiency (party distribution). For each function we find an optimal redistricting, and compare with results from other functions in the space. This allows us to identify characteristics that lead to a more fair district and to quantify differences between redistricting plans.

Political Parties and Lottery Voting

Stephanie Thrash & Nicole Buczkowski, St. Edward's University

Standard voting methods rely on deterministic social choice functions to aggregate voter preferences and determine a winner or set of winners. In contrast, lottery voting determines winners by randomly selecting voter ballots. In this talk, we will investigate lottery voting from a mathematical perspective. In particular, we will provide insight into optimal strategies for political parties within the lottery voting system.

Modeling the effects of the immune system on the fracture healing process

Imelda Trejo & Hristo V. Kojouharov, University of Texas at Arlington

Immune system cells play a key role in the fracture healing process. At the early stage of the process, they clean up the injury site, control the inflammation and enhance bone reconstruction. Moreover, immune cells release pro-inflammatory molecules that promote the osteogenic activities. However, the mechanisms and functions of immune cells present at the fracture site is not clearly understood. In this work, we present a mathematical model for the bone healing process incorporating both immune and bone cells. Our model consists of a system of nonlinear ordinary differential equations which represents the interactions among the macrophages, mesenchymal stem cells, chondrocytes and osteoblast cells in the bone healing process. The interaction among those cells are governed by three molecules: growth factors, pro- and anti-inflammatory cytokines. We use the model to simulate the progression of healing for different types of fractures. A set of numerical simulations is also presented to examine the effect of inflammatory molecules on the outcome of bone repair. Our mathematical model reproduces an accurate bone healing time under a healthy body conditions, according on the statistical data. This model also capture delayed healing.

Chaos Control: Applying Control Theory to Chaos

Zachery Viray, University of the Incarnate Word

Dynamical systems are sets of possible states where the present state is determined by a rule on the previous state, we will be looking at both discreet and continuous dynamical systems with multiple dimensions. When the behavior of a dynamical system becomes unpredictable, it is considered a chaotic system, such systems can contain as few as one variable. Our objective is to understand how to control these systems and be able to increase or decrease the amount of chaos.

Transcendental functions with a complex twist

Michael Warren, John Gresham & Bryant Wyatt, Tarleton State University

When we ask students to find the solutions to polynomial equations like $x^2 + 4 = 0$ we expect them to know that though this equations have no real solutions it has complex solutions. However, if we ask students to find the solutions to equations like $sin(x) + 4 = 0$ or $e^x + 4 = 0$ we leave them completely in the dark and never address these questions. Students have no idea that such solutions exist just as they did with polynomials. Students may run across these problems if they take an upper level course in complex analysis but they are presented in a 4 dimensional setting which is hard to visualize. Here we show how to use domain restriction coupled with the 3D graphing capabilities of GeoGebra to give student the ability to visualize the non-real components and structure of transcendental functions.

Creating an Isotopically Similar Earth-Moon system with Correct Angular Momentum from a Giant Impact

Bryant Wyatt, Tarleton State University

The giant-impact hypothesis is the dominant theory as to how the Earth-Moon system was formed, but angular momentum concerns have cast a shadow on its validity. Computer generated impacts have been successful in producing virtual Earth-Moon systems that possess many of the properties of the observed system, but when tasked with addressing the isotopic similarities between the Earth and Moon they result in systems with excessive angular momentum. Evection resonance between the Moon and the Sun has been put forth as a means of removing the excess angular momentum, but this reasoning was rejected by The Royal Society at a special session called to discuss the origin of the Moon. Here we show how to use impactor spins to create an impact that preserves all the favorable aspects of previous simulations, and produces an Earth-Moon system with the correct angular momentum. Evection resonance is not needed.

Enumerating kth Roots in the Symmetric Inverse Monoid

Christopher W. York, Lamar University

The symmetric inverse monoid, SIM(n), is the set of all partial one-to-one mappings from the set 1, 2,. . ., n to itself under the operation of composition. Earlier research on the symmetric inverse monoid delineated the process for determining whether an element of SIM(n) has a kth root. The problem of enumerating kth roots of a given element of SIM(n) has since been posed, which is solved in this work. In order to find the number of kth roots of an element, all that is needed is to know the cycle and path structure of the element. Since the enumeration problem has been completed for the symmetric group, this research only focuses on the cycle-free elements of SIM(n). The formulae derived for cycle-free elements of SIM(n) utilize integer partitions, similar to how they are used in the expressions given for the number of kth roots of permutations.