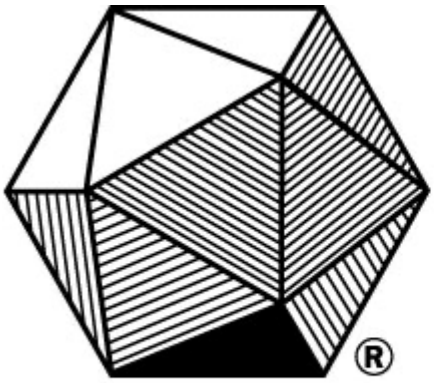

MAA

MATHEMATICAL ASSOCIATION OF AMERICA

83rd Annual Meeting of the Oklahoma – Arkansas Section

Virtual Meeting
Hosted by
Henderson State University
April 7-9, 2022

MAA Core Interests:
Education
Research
Professional Development
Public Policy
Public Appreciation

OK-AR Section Website
http://sections.maa.org/okar

Executive Committee
2021 – 2022

John Diamantopoulos (NSU), Past Chair
Ronald Smith (HU), Chair
Carolyn Eoff (HSU), 1st Vice Chair
Nicholas Jacob (ECU), 2nd Vice Chair
Sarah Marsh (OKBU), Secretary
Kristi Karber (UCO), Treasurer
Christopher Sauer (CU), Communications Director
Britney Hopkins (UCO), Section Representative

Abbreviations for Institutions Represented in this Program Book

AC	Amherst College
ATU	Arkansas Tech University
BSU	Ball State University
CSUSM	California State University San Marcos
CU	Cameron University
CWU	Central Washington University
DC	Dallas College
ECU	East Central University
HU	Harding University
HSU	Henderson State University
NOAA	National Oceanic and Atmospheric Administration
SPC	Storm Prediction Center
NSU	Northeastern State University
OBU	Ouachita Baptist University
OKBU	Oklahoma Baptist University
OSU	Oklahoma State University
OU	University of Oklahoma
SNU	Southern Nazarene University
SWOSU	Southwestern Oklahoma State University
UAF	University of Arkansas
UAFS	University of Arkansas – Fort Smith
UALR	University of Arkansas, Little Rock
UAM	University of Arkansas at Monticello
UAPB	University of Arkansas at Pine Bluff
UCO	University of Central Oklahoma
UMD	University of Minnesota Duluth
WOU	Western Oregon University

Meeting Overview

All times Central Daylight Time

Thursday, April 7

5:00 pm	Section NExT
5:00 pm	Undergraduate Competitions Begin
5:30 – 8:00 pm	Team Jeopardy Competition
8:00 pm	Integration Bee

Friday, April 8

10:00 – 11:00 am	Department Chairs Meeting
1:00 – 3:15 pm	Presented Papers
4:00 – 5:15 pm	Section Business Meeting
6:30 – 7:45 pm	Awards Ceremony
8:00 – 9:00 pm	Section Visitor Lecture *On Euler's Partition Theorem Relating Odd-Part Partitions and Distinct-Part Partitions*. James Sellers, University of Minnesota Duluth Past Secretary of the MAA

Saturday, April 9

8:00 – 8:55 am	Presented Papers
9:10 – 9:55 am	MAA AWM Lecture (in partnership with the Association for Women in Mathematics) *Heuristic Framework for Multi-Scale Testing of the Multi-Manifold Hypothesis.* Karamatou Yacoubou Djima, Amherst College
10:10 – 11:40 am	Student Workshop, *The Mathematics of Labyrinths*. Nicholas Zoller, Southern Nazarene University
10:10 am – 12:40 pm	Faculty Workshop, *Cryptology: An Introduction to breaking classical codes and ciphers.* Cheryl Beaver, Western Oregon University Stuart Boersma, Central Washington University

Full Meeting Schedule

Thursday Evening, April 7, 2022

5:00 pm	**Section NExT**, Coordinator: Kristi Karber
5:00 pm	**Competitions for Undergraduates** Presiding: Scott McClendon
5:30 – 8:00 pm	**Team Jeopardy Competition**
8:00 – 12:00 pm	**Integration Bee**

Friday Morning, April 8, 2022

10:00 – 11:00 am	**Department Chairs Meeting** Presiding: Carolyn Eoff

Friday Afternoon, April 8, 2022
Presented Papers
1:00 – 3:15 pm

Session 1 (Undergraduate): Mathematics Education and Analysis, 1:00 – 2:35 pm, Breakout Room 1

1:00 - 1:15 pm **Calculus Through Coding**
Tia Boyd (UAPB)
Mentor: Anna Harris
Abstract: In this presentation, I will be discussing a new method of learning Calculus. What is this new method of learning? Coding. Coding is a wonderful, innovative tool that is growing in importance as a job skill. Not only is coding valuable for the workforce, but it is a great instrument for learning. Coding allows students to develop problem-solving skills and critical thinking skills. These same skills are heavily used within Calculus. By teaching Calculus through coding, students will develop critical thinking skills while learning new mathematical skills, improving their overall academic performance.

(*continued, next page*)

Session 1 (Undergraduate), continued

1:20 - 1:35 pm **What Does Being a Peer Lead Team Leader Have To offer?**
Brooke Davis (UAPB)
Mentor: Anna Harris
Abstract: For The first part of my presentation, I will define what being a peer lead team leader means to me and I will also speak about what I do and how my schedule is set up and my day-to-day duties. Next, I will talk about how I became a PLTL, why I was chosen and what adjustments I had to make being a PLTL and a student and how I balance both. Then I will go into detail about the benefits it offers such as being able to build on my knowledge of calculus , being paid to help others, seeing others grow in their knowledge of calculus, gaining opportunities such as internships because of my experience, etc. Next, I will go into detail about how PLTL has helped me to increase my social skills and leadership skills. When closing I will talk about why I like being a PLTL and why it is not like other tutoring sessions and how I have benefited from it from an academic standpoint.

1:40 - 1:55 pm **Evidence Based Learning in Calculus**
Ashley Allen (UAPB), Jason Sanders (UAPB), and Kobe Garrett (UAPB)
Mentor: Anna Harris
Abstract: In this presentation, we will talk about the different evidence-based learning methods utilized in this calculus class with Dr. Harris. We used Blackboard paper assignments, Julia coding (CoCalc,) PLTL(peer-lead- team-learning,) recorded lectures, and WebAssign. Julia coding in CoCalc was used to learn limits graphically and numerically, and applications of derivatives. We attended PLTL study sessions as a part of required coursework, and the peer leaders were chosen by Dr. Harris from her previous Calculus students or current class. We usually go over assignments, and practice difficult concepts. Through these evidence based instructions, students gained a deeper understanding of the concept and improved retention of the material.

2:00 - 2:15 pm **Taxicab Geometry**
Jaime Acre (SNU), Caleb Cornelius (OBU)
Mentor: Nicholas Zoller
Abstract: Taxicab Geometry is a non-Euclidean geometry that measures distance based on an “ideal city” grid in which you can only make 90 degree turns. Our research was conducted to explore properties of Taxicab Geometry in an attempt to discern whether Kepler's laws of planetary motion will hold in this non-Euclidean geometry, and if so, what forms might they have? The general formulas for the area and perimeter of Taxicab circles and ellipses are proved in an attempt to derive Kepler’s second law of planetary motion. This leads to a discussion on eccentricity and planetary orbits, followed by a brief discussion on the area of a sector in a circle.

2:20 - 2:35 pm **Equidistant in Spherical Geometry**
Madison Gilbert (SWOSU)
Mentor: Hung-Chieh Chang
Abstract: The procedure of finding the point on a sphere equidistant to the vertices of a spherical triangle.

Session 2 (Undergraduate): Applied Mathematics, Statistics, and Mathematical Physics, 1:00 – 2:15 pm, Breakout Room 2

1:00 - 1:15 pm **Neutralizing Sulfur Mustard and Tear Gas in Aquatic Environment**
Anel Montiel (UAFS)
Mentors: Chizuko Iwaki, Noel Sagullo, Archana Mishra
Abstract: Using previously collected data, a theoretical way will be in practice to determine how to neutralize the chemical agents based on the determination of the LC-MS, using statistical analysis. Based on the sulfur mustard chemical compound formula, chlorine will be neutralized since it has a strong electronegativity according to the periodic table. From there, further research of a different chemical substance will be used to help neutralize the sulfur. Then for the tear gas with a chemical element of chlorine, will be neutralized due to its electronegativity since it is strong according to the periodic table and then the oxygen will be oxidized to reach a neutralized state.

1:20 - 1:35 pm **The Mathematical Principles Applied in the Discovery of the Layers of the Earth**
Jaxen Morphis (UAM)
Mentor: Lynn Fox
Abstract: In 1936, Inge Lehmann, a mathematician in the field of seismology, discovered that there were more layers within the Earth than previously thought. She noted after a 1929 earthquake in New Zealand that the seismic waves were being detected on areas of the Earth where they should not have been detected at all, with respect to the latest model of the layers of the Earth. Lehmann applied geometry, trigonometry, Fermat's principle, and the Laws of Refraction and Reflection to reach the conclusion that there were, perhaps, more layers within the planet that caused these waves to be detected in these gray areas. We will discuss these mathematical principles used by Inge Lehmann in the discovery of the multiple layers of the Earth.

1:40 - 1:55 pm **The Background and Analysis of the applications of Markov Matrices and the Markov Chain**
Noah Smith (UAM)
Mentor: Victoria Fox
Abstract: I intend to do my research and presentation on Markov Matrices. I will focus my research on the history, the Aspects, and a few of the main applications for which Markov Matrices would be used. The Applications I will focus on will be the Migration Matrix and how the Markov Matrix can predict the distant future using Markov Chain.

2:00 - 2:15 pm **Time Dilation**
Ojani Chacon (UAM)
Abstract: With the concept of time, time dilation is an amazing event that is constantly happening in the universe. Because of time the human mind can quantify how an object changes its position through mobility. Time dilation put simply is a phenomenon in which the perception of time passes slower for an observer who is moving relative to another observer depending on the relative motion or position on a gravitational field. Time dilation was discovered by Albert Einstein in his theory of relativity. His idea states that gravity plays a big on the concept of time. So why does time become distorted when it is affected by gravity? This is thanks too Special and General Relativity.

Session 3: Mathematics Education and Classroom Notes, 1:00 – 2:15 pm, Breakout Room 3

1:00 - 1:15 pm **Extra Credit through Detailed Solutions**
Scott Williams (UCO)
Abstract: A familiar scenario to many of us is the flood of questions/emails after a low-scoring exam asking about test corrections, a re-do, or bonus points. If we decide that something should be done to boost the class average, what options do we have to fairly do so? In this talk we will describe one possible method which we have used in our Calculus 2 course where students are asked to provide detailed solutions, not just equations/computations, which walk the reader though all of the steps necessary to solve a given problem.

1:20 - 1:35 pm **A Different Kind of nonEuclidean Geometry**
Erin Williams (UCO)
Abstract: Developing the concepts in College Geometry axiomatically is a challenge. Students have known Euclidean Geometry for so long it is difficult for them to follow with fresh eyes. Yet, when exploring something new, like Hyperbolic geometry, the investigation quickly gets complicated and requires a high level of mathematical maturity. Changing how distance is measured and using Taxicab Geometry transforms many common geometric concepts. This new world is familiar enough to get all students to participate, yet different enough to cause the bright students to pause before they answer.

1:40 - 1:55 pm **Virtual Outreach to an In-Person Middle School Classroom**
Cynthia Francisco (OSU)
Abstract: The pandemic has continued to disrupt K-12 outreach as many schools restrict visitors. Amid uncertainty about the future, I am interested in using technology to reach broader audiences regardless of the status of the pandemic. During the fall of 2021, I worked with the American Institute of Mathematics as a fellow in their MATCH program to conduct virtual visits to a middle school classroom at a Title I school in Arizona. I will discuss these visits and the potential for future outreach.

2:00 - 2:15 pm **The Mathematical Inquiry Project: Key Conceptual Themes in Entry-Level Math Courses**
Allison Dorko (OSU), Michael Tallman (OSU), John Paul Cook (OSU), Michael Oehrtman (OSU), Josiah Ireland (OSU), Bus Jaco (OSU)
Abstract: The Mathematical Inquiry Project (MIP) is a long-term collaboration of mathematics faculty across the 27 institutions of higher education in Oklahoma. To date, faculty have participated in four week-long workshops focused on identifying key conceptual themes in the following courses: quantitative reasoning, college algebra, precalculus, and calculus. A fifth workshop focused on academic success skills. All the workshops centered on connecting the conceptual themes to the MIP's three pillars of inquiry: academic success skills, meaningful applications, and active learning. In this talk, we will report on the conceptual themes the Oklahoma faculty collectively identified and some of the mathematical tasks faculty members have developed that help students develop those conceptual ideas via the pillars of inquiry.

Session 4: Number Theory, Analysis, Geometry, and Topology, 1:00 – 2:35 pm, Breakout Room 4

1:00 - 1:15 pm **Euler's Approach to the Basel Problem and an Infinite Product**
Michael Fulkerson (UCO)
Abstract: A famous problem in Euler's day (called the Basel problem) was to find the sum of the series 1+(1/4)+(1/9)+(1/16)+... Euler showed that the series converges to (pi^2)/6. In this talk, we investigate the techniques Euler used in his solution as well as an application to a related infinite product expansion for pi/2.

1:20 - 1:35 pm **Homoclinic intersections of some lemon-shaped billiards**
Pengfei Zhang (OU)
Abstract: In this talk we will introduce the dynamical billiards on a lemon-shaped table Q(b), where Q(b) is the intersection of two unit disks with center distance b. We will show that for some parameter b, the billiard map on the lemon table Q(b) admits crossing homoclinic and heteroclinic intersections. In particular, such lemon billiards have positive topological entropy. This is based on a joint work with Dr. Jin.

1:40 - 1:55 pm **Average principles with applications**
Shihshu Walter Wei (OU)
Abstract: We will state various average principles with analytic, geometric and physical interpretations. We will also show how they interact and are used to solve challenging problems in research.

2:00 - 2:15 pm **Using quaternions to prove theorems in spherical geometry**
Marshall Whittlesey (CSUSM)
Abstract: The complex numbers can be used to do geometric transformations in the plane. In a similar manner, the quaternions can be used to do geometric transformations in three-dimensional space. In this talk we show how to use quaternions to prove a significant classical theorem in spherical geometry. These methods are featured in the speaker's new book with CRC Press, *Spherical Geometry and its Applications*, which the author hopes will be attractive for use in topics courses in geometry.

2:20 - 2:35 pm **Necessary Conditions for a Fixed-Point of Maps in Non-Metric Spaces II**
Ivan Raykov (UAPB)
Abstract: We introduce a map on a non-metric space with a fixed-point using a contraction map on a metric topological space and a function between the metric topological and a non-metric topological space satisfying the definition of limit on non-metric spaces.

Session 5: Applied Mathematics, 2:40 – 3:15 pm, Breakout Room 1

2:40 - 2:55 pm **Simulating Craps Game**
Nicholas Jacob (ECU)
Abstract: The game of craps is a simple betting game with dice. We'll examine simulations using python and suggest how a small change in the game can make a large difference in the expected outcome for a player.

3:00 - 3:15 pm **Simulations and Modeling of Turbulent mixing**
Tulin Kaman (UAF)
Abstract: Turbulent mixing due to the hydrodynamic instabilities occurs in a wide range of scientific and engineering problems. We present an increasingly accurate and robust front tracking method used for the numerical simulations of Rayleigh-Taylor Instability (RTI) and Richtmyer-Meshkov Instability (RMI) to estimate the growth rate of interfaces between two fluids of different densities with constant and impulsive acceleration. We present our successful verification and validations studies for the simulations of RTI experiments of Smeeton-Youngs (1989) and RMI experiments of Collins and Jacobs (2002).

Session 6: Statistics and Statistics Education, 2:20 – 3:15 pm, Breakout Room 2

2:20 - 2:35 pm **Student Engagement Using Top Hat in Introductory Statistical Methods**
Lakeshia Legette Jones (UALR)
Abstract: Top Hat is an all in one, active learning platform for all modes of delivery and designed for mobile access. It allows for interactive syllabi and textbooks with embedded content, such as questions, comments, and videos. It offers multiple question types and the ability to make just-in-time accommodations to respond to student needs. This presentation will share some features of Top Hat and show how it can be used to increase student engagement and overall satisfaction. I will give a report of student performance and qualitative feedback from asynchronous courses in fall 2021.

2:40 - 2:55 pm **Statistical model for the Success of the Glass Bridge at Squid Game**
Daiho Uhm (UAFS)
Abstract: In the Netflix series Squid Game, the fifth of these tests consists of crossing a floating bridge with 18 glass steps, separated by one meter. Each step is made up of two tiles, one of tempered glass, capable of supporting the weight of a person, and the other of normal glass, which breaks when stepped on. Sixteen players will try to cross the bridge one after the other, choosing one of the two tiles at each jump. If one player falls, the next player advances through the safe tiles up to the previous player's position and tries to cross the rest.
Consider statistical models for some questions;

1. How many final broken glasses when the test is done?
2. How many plyers would survive on average?
3. What is my chance of crossing the bridge?
4. What is my chance of crossing the bridge if I am 4th player and the 1st player is on the 10th step?

3:00 - 3:15 pm **Math and Field Work: A Scalable Cross-Disciplinary Undergraduate Research Project on Stream Litter Accumulation**
Emily Hendryx (UCO)
Abstract: A team of six undergraduate students and three faculty members engaged in a 12-week project studying litter accumulation in local waterways. Students gained hands-on experience in conducting cross-disciplinary research, collecting data and performing subsequent analyses and modeling. With little required equipment and many possible research questions to adapt and explore, this project may offer some ideas to others looking to involve students in the research process at their institutions.

Session 7: Mathematics Education – Calculus, 2:20 – 3:15 pm, Breakout Room 3

2:20 - 2:35 pm **Helping Entry-Level Math Students Understand Concavity**
Allison Dorko (OSU), John Paul Cook (OSU)
Abstract: Students often understand concavity in terms of "concave up like a cup, concave down like a frown." This can be helpful, but we would also like our entry-level students to understand concavity in terms of rates of change. In this talk, we will describe how we teach concavity in Math 1483 (Mathematical Functions and their Uses). We will share tasks that help students develop quantitative and covariational meanings for concavity. This talk is intended to be useful for instructors of entry-level math and calculus.

2:40 - 2:55 pm **Teaching Calculus Using Infinitesimals**
Nicholas Zoller (SNU)
Abstract: Infinitesimals were used in calculus from its beginnings. However, efforts to put calculus on a rigorous foundation in the nineteenth century left infinitesimals out of the picture. Robinson revived them in the middle of the twentieth century by putting them on an equally rigorous foundation. In the past two years, I was a classroom tester for a calculus textbook that uses infinitesimals. I am convinced that it is a powerful method for introducing students to calculus that also stays true to its historical roots.

3:00 - 3:15 pm **Calculus Evidence-Based Instructions – Engage Students and Enhance Students' Learning**
Anna Harris (UAPB)
Abstract: Calculus is one of the bottleneck classes for STEM majors at UAPB. Since it is a five credit hours class, it greatly affects students' GPA if they fail this class. Furthermore, some students even change their STEM major to a non-STEM major due to failing Calculus class two times or more. As an HBCU we have an obligation to produce more STEM minority professionals since there is a lack of minority STEM workforce in the USA. As one of my NSF HBCU-UP Targeted Infusion Project grant implementation, I have applied several active-learning instructions and technologies to enhance students' learning and engagement. In this presentation, I will share how I engage my Calculus students and enhance their learning by utilizing evidence-based instructions.

Session 8: Educational Technology, 2:40 – 3:15 pm, Breakout Room 4

2:40 - 2:55 pm **Dynamic Environments for Taxicab, Hyperbolic, and Spherical Geometries in GeoGebra**
Jack Jackson (UAFS)
Abstract: We demonstrate the use of two GeoGebra activities Dr. Jackson created for exploring geometry. One is for Euclidean, Taxicab, and Hyperbolic Geometries and the other is for Spherical Geometry. These applets include non-Euclidean versions of the tools that are included in GeoGebra for Euclidean Geometry. Both of these and other apps are publicly available via the GeoGebra Book Geometry Collected Resources: https://www.geogebra.org/m/xkrdwnhs.

3:00 - 3:15 pm **Using Desmos in Upper-Level Mathematics Courses**
Matthew Lynam (ECU)
Abstract: Desmos is an online graphing calculator, often used in Algebra or Trigonometry courses. However, Desmos can also be useful in upper-level courses, such as Introduction to Real Analysis. This talk will look at some Desmos graphs that can help students visualize important concepts in upper-level math courses.

Friday Afternoon, April 8, 2022
Section Business Meeting
4:00 – 5:15 pm

Presiding: Ronald Smith, Section Chair

Friday Evening, April 8, 2022
Annual Awards Ceremony
6:30 – 7:45 pm

Presiding
Carolyn Eoff, Henderson State University

Official Welcome
Dr. Chuck Ambrose, Chancellor, Henderson State University

Putnam Examination Award
Presented by Nicholas Zoller, Southern Nazarene University

Milestones
Presented by Sarah Marsh, Oklahoma Baptist University

R. B. Deal Awards for Student Oral Presentations
Presented by Kristi Karber, University of Central Oklahoma

Student Contest Awards
Presented by Scott McClendon, University of Central Oklahoma

Arkansas Teacher Awards
Presented by Javier Taylor, University of the Ozarks

MAA Section Visitor Lecture

On Euler's Partition Theorem Relating Odd-Part Partitions and Distinct-Part Partitions

James Sellers

University of Minnesota Duluth

Past Secretary of the MAA

8:00 – 9:00 pm

Presiding: Ronald Smith, Section Chair

Abstract: In the mid-18th century, Leonhard Euler single-handedly began the serious study of integer partitions and made fundamental contributions to the area for the next few decades. In particular, he proved a remarkable result which says that the number of partitions of the integer n into distinct parts equals the number of partitions of n into odd parts. My goal in this talk is to discuss Euler's impressive work on partitions, including snapshots of historical (original) publications of Euler, and then to describe numerous 20th and 21st century results which spring from Euler's original result. The talk will be self-contained and geared for both students and faculty alike.

About the Speaker: James Sellers received his Ph.D. from Penn State University in 1992. After receiving his PhD, he taught at Cedarville University in Ohio for nine years before returning to his alma mater in 2001 to serve as a faculty member and the director of the undergraduate program in mathematics. In 2008, James served as a Visiting Fellow of the Isaac Newton Institute in Cambridge, and in 2012 he was privileged to be a Fulbright scholar, teaching and completing research at the Johannes Kepler University and the Research Institute for Symbolic Computation in Linz, Austria. Currently, James has over 100 research papers listed in Mathematical Reviews, and he has won numerous awards for both his teaching and his service to the mathematical community. In February 2018, James turned his attention to a new and very exciting opportunity – serving as the Secretary of the MAA! (He completed his term of service in February 2022.) And in August 2019, he moved to the University of Minnesota Duluth to join the Department of Mathematics and Statistics there.

Saturday Morning, April 9, 2022
Presented Papers
8:00 – 8:55 am

Session 9 (Undergraduate): Applied Mathematics and Statistics, 8:00 – 8:55 am, Breakout Room 1

8:00 - 8:15 am **Outer Billiard Visualization Algorithms**
David Brock (DC)
Mentor: Byungik Kahng
Abstract: We study the efficient calculation and visualization of the singularity structure of outer billiards (or dual billiards) on regular polygons, which often gives rise to intricate and beautiful fractal structures. By leveraging key properties of the outer billiards transformation, several major improvements are made to a baseline algorithm, so it runs faster, uses less memory, and generates higher resolution images.

8:20 - 8:35 am **Mathematical Analysis of an SIR Disease Model with Non-Constant Transmission Rate**
Emma Bollinger (SWOSU), Tayler Valdez (SWOSU)
Mentors: Sunil Giri, Swarup Ghosh
Abstract: Mathematical modeling can be an extremely effective tool in our understanding of disease dynamics. Epidemiological models consist of differential equations made up of standard parameters that closely portray disease dynamics. In this talk, we will overview the governing parameters and mathematics modeling a measles-like disease. This model is unique because the transmission rate varies linearly with the size of the infectious class. After examining a simple SIR model, we will explore the use of linearization, Jacobian matrices, and characteristic eigenvalue equation analysis to obtain the threshold “reproduction number”. We will then use this information to obtain the disease-free equilibrium and the endemic equilibrium and show that the disease-free equilibrium is locally stable when the reproduction number is less than one.

8:40 - 8:55 am **Identifying Predictors of Treatment Response from Electrocardiogram Data**
Imuseoluwa Obembe (UCO)
Mentor: Emily Hendryx
Abstract: The goal of this research is to predict the response of patients with Paroxysmal Atrial Fibrillation (PAF) to a non-invasive treatment: low-level electrical stimulation of the vagus nerve. In particular, we are developing statistical models to identify possible predictors from PAF patient electrocardiogram (ECG) data. This talk presents our preliminary work toward such feature derivation and model construction.

Session 10: Statistics Education and Applied Mathematics, 8:00 – 8:55 am, Breakout Room 2

8:00 - 8:15 am **Development of Interdisciplinary Research Collaborative to Provide Datasets in Support of Education Research in Data Science**

Weijia Jia (ATU)

Abstract: All the key industries are looking for professionals who can generate value out of data critically and scientifically. Data science and statistics education plays a crucial role in answering this challenge. This research project works on collecting a series of datasets from different disciplines related to the research of faculty members at Arkansas Tech University (ATU) and preparing data science and statistics course projects and capstone projects. The research project aims at opening the door of the data life cycle to the students in data science and statistics-related classes, instilling curiosity about the data, motivating the students, and better preparing them to enter the workforce.

8:20 - 8:35 am **Using Statistical Simulation to Estimate Impacts of Tornado Outbreaks Before they Occur**

Patrick Marsh (NOAA SPC)

Abstract: The NOAA Storm Prediction Center (SPC) built a statistical framework, Integrated Machine-based Predictive Analytics for Convective Threats to Society (IMPACTS), to simulate societal impacts of tornado outbreaks. IMPACTS consists of two components: a "weather generator" to simulate the number, location, and intensity of tornadoes and a method of assessing societal impacts from these simulations. This presentation will discuss the statistical development of IMPACTS.

8:40 - 8:55 am **Mathematical Model of Plasmin to Treat Ischemic Stroke**

Rahma Ouedraogo (UCO)

Mentor: Brittany Bannish

Abstract: We built a stochastic mathematical model, based on the Gillespie algorithm, to investigate the use of plasmin as a stroke treatment. In this talk, we will describe the model and present results about how blood clot degradation depends on different biological rate constants.

Session 11: Educational Technology and Mathematics Education, 8:00 – 8:55 am, Breakout Room 3

8:00 - 8:15 am **The power of dynamic geometry software to facilitate the process of posing geometric conjectures and problems**

Jose Contreras (BSU)

Abstract: The formulation of conjectures and problems are fundamental processes of mathematical activity. In this presentation, I illustrate how we can use dynamic geometry software and a problem posing framework to provide opportunities for students to formulate special, extended, and general problems related to the following problem: What type of quadrilateral has as vertices the points of intersection of the bisectors of the angles of a parallelogram?

8:20 - 8:35 am **Visual Proofs by Animated GIFs: Revisited**

John Diamantopoulos (NSU)

Abstract: Some proofs are quite naturally done as "proofs without words". Creating animations to represent such proofs can really make them "come to life" for the students. Previously I shared some examples that I'd created using animated GIFs, but come and see the exciting adaptations I made! I will draw comparisons with what I'd previous shown vs. what I was able to implement within Geogebra!

8:40 - 8:55 am **Modeling Problems with GeoGebra: The Picnic Problem**

Jose Contreras (BSU)

Abstract: In this presentation I will illustrate how learners can use GeoGebra as a tool to facilitate solving geometric problems. In particular, I will explore the picnic problem (a version of Viviani's problem): Three towns are the vertices of an equilateral triangle. The sides of the triangle are the roads that connect the towns. A picnic area will be constructed such that the sum of its distances to the roads is as small as possible.

1. What are all the possible locations for the picnic area?
2. For practical reasons, what is the best location for the picnic area? Justify your response.

Session 12: Mathematics Education, Discrete Mathematics, and Topology, 8:00 – 8:55 am, Breakout Room 4

8:00 - 8:15 am **Interactive Classroom Activities**
Kayla Murray (UAFS)
Abstract: Prior to the pandemic, I used Plickers in my classrooms. These provided a way to engage students with an interactive activity that allowed real-time feedback about student understanding. With the need for remote class formats during the pandemic, I switched to using an application called Quizizz to help facilitate student engagement and participation. I will be discussing my background using such interactive activities and the implementation of these through Quizizz.

8:20 - 8:35 am **Anti-magic Domino Squares and Rectangles**
Kayla Murray (UAFS)
Abstract: One variation of magic squares is anti-magic squares. With anti-magic squares, a square grid is filled with integers in such a way so that the row, column, and diagonal sums form a sequence of consecutive integers. We investigated anti-magic squares (and similarly anti-magic rectangles) that are formed from domino pieces. In this talk, we will cover what we know about these objects and discuss the open questions that remain. This is joint work with a former student, Sara Whatley.

8:40 - 8:55 am **Stability of sparse circular coordinates**
Hitesh Gakhar (OU)
Abstract: Recently, a few topological algorithms were created to aid nonlinear dimensionality reduction, which becomes useful when the ambient dimension of a dataset greatly exceeds its intrinsic one. The algorithms use persistent cohomology on a sample and construct functions into an Eilenberg-MacLane space like a circle, projective space, or lens space. In this talk, I will show that even though circular coordinates depend on the sample, this process is stable with respect to small perturbations.

MAA AWM Lecture

(in partnership with the Association for Women in Mathematics)

Heuristic Framework for Multi-Scale Testing of the Multi-Manifold Hypothesis

Karamatou Yacoubou Djima

Amherst College

9:10 – 9:55 am

Presiding: Ronald Smith, Section Chair

Abstract: Global linear models often overestimate the number of parameters required to analyze or efficiently represent datasets, for example when a data set in sampled from a manifold of lower dimension than the ambient space. The manifold hypothesis consists in asking whether data lies on or near a d-dimensional manifold or is sampled from a distribution supported on a manifold. In this talk, we outline a heuristic framework for a hypothesis test suitable for computation and empirical data analysis. We consider two datasets made of multiple manifolds and test our manifold hypothesis on a set of spline-interpolated manifolds constructed based variance-based intrinsic dimensions computed from the data. This is joint work with Patricia Medina, Linda Ness and Melanie Weber.

About the Speaker: Dr. Karamatou Yacoubou Djima is an applied mathematician and an Assistant Professor of Mathematics at Amherst College. Before moving to Amherst, she spent a year at Swarthmore College as a visiting postdoctoral fellow. She received both her Ph.D. and MSc in Applied Mathematics & Statistics and Scientific Computing from the University of Maryland in College Park. Dr. Yacoubou Djima's current research interests lie at the intersection of applied harmonic analysis and machine learning. Her past and ongoing projects include novel spectral graph methods, early diagnosis of autism spectrum disorder using features present in placenta images, and motion detection in animated images for Pixar.

10:10 – 11:40 am **Student Workshop, Breakout Room 1**
Presiding: Michael Lloyd (HSU)

The Mathematics of Labyrinths
Facilitator: Nicholas Zoller, Southern Nazarene University

Abstract: A labyrinth is a maze in which a visitor to the maze follows exactly one path while passing through it. They have been a part of human civilizations since ancient times. Some of the most famous examples are laid out on the floors of Catholic cathedrals in Europe. In this workshop, we will learn about the mathematical properties of labyrinths. Then we will use those properties to build our own labyrinths.

10:10 am – 12:40 pm **Faculty Workshop, Breakout Room 2**
Presiding: Fred Worth (HSU)

Cryptology: An Introduction to breaking classical codes and ciphers
Facilitators: Cheryl Beaver, Western Oregon University
Stuart Boersma, Central Washington University

Abstract: The codebreaking competition, KRYPTOS, is two weeks after this meeting (April 21-25). Come and hear about KRYPTOS, learn about some ciphers, and test your skills at cryptanalysis! Helpful online cryptanalysis tools will be shared with participants together with some tried and true pencil and paper techniques. Students and faculty alike are encouraged to attend.

Schedule of Presented Papers by Time of Presentation

Explanation of Column Headings:

- *Name*: Last name of first presenter
- *Title*: Title of presentation
- *Room*: Breakout Room in Zoom
- *Session*: Session Number. Abstracts of presentations are given in the program arranged by session. Sessions of undergraduate presenters are identified by *UG*.

Friday Afternoon, April 8

1:00 – 1:15 pm

Name	*Title*	Room	Session
Boyd	*Calculus Through Coding*	1	UG1
Montiel	*Neutralizing Sulfur Mustard and Tear Gas in Aquatic Environment*	2	UG2
Williams, S.	*Extra Credit through Detailed Solutions*	3	3
Fulkerson	*Euler's Approach to the Basel Problem and an Infinite Product*	4	4

1:20 – 1:35 pm

Name	*Title*	Room	Session
Davis	*What Does Being a Peer Lead Team Leader Have To offer?*	1	UG1
Morphis	*The Mathematical Principles Applied in the Discovery of the Layers of the Earth*	2	UG2
Williams, E.	*A Different Kind of nonEuclidean Geometry*	3	3
Zhang	*Homoclinic intersections of some lemon-shaped billiards*	4	4

1:40 – 1:55 pm

Name	*Title*	Room	Session
Allen	*Evivdence Based Learning in Calculus*	1	UG1
Smith	*The Background and Analysis of the applications of Markov Matrices and the Markov Chain*	2	UG2
Francisco	*Virtual Outreach to an In-Person Middle School Classroom*	3	3
Wei	*Average principles with applications*	4	4

2:00 – 2:15 pm

Name	*Title*	Room	Session
Acre	*Taxicab Geometry*	1	UG1
Chacon	*Time Dilation*	2	UG2
Dorko	*The Mathematical Inquiry Project: Key Conceptual Themes in Entry-Level Math Courses*	3	3
Whittlesey	*Using quaternions to prove theorems in spherical geometry*	4	4

2:20 – 2:35 pm

Name	*Title*	Room	Session
Gilbert	*Equidistant in Spherical Geometry*	1	UG1
Legette Jones	*Student Engagement Using Top Hat in Introductory Statistical Methods*	2	6
Dorko	*Helping Entry-Level Math Students Understand Concavity*	3	7
Raykov	*Necessary Conditions for a Fixed-Point of Maps in Non-Metric Spaces II*	4	4

Friday Afternoon, April 8, continued

2:40 – 2:55 pm

Name	*Title*	Room	Session
Jacob	*Simulating Craps Game*	1	5
Uhm	*Statistical model for the Success of the Glass Bridge at Squid Game*	2	6
Zoller	*Teaching Calculus Using Infinitesimals*	3	7
Jackson	*Dynamic Environments for Taxicab, Hyperbolic, and Spherical Geometries in GeoGebra*	4	8

3:00 – 3:15 pm

Name	*Title*	Room	Session
Kaman	*Simulations and Modeling of Turbulent mixing*	1	5
Hendryx	*Math and Field Work: A Scalable Cross-Disciplinary Undergraduate Research Project on Stream Litter Accumulation*	2	6
Harris	*Calculus Evidence-Based Instructions – Engage Students and Enhance Students' Learning*	3	7
Lynam	*Using Desmos in Upper-Level Mathematics Courses*	4	8

Saturday Morning, April 9
8:00 – 8:15 am

Name	*Title*	Room	Session
Brock	*Outer Billiard Visualization Algorithms*	1	UG9
Jia	*Development of Interdisciplinary Research Collaborative to Provide Datasets in Support of Education Research in Data Science*	2	10
Contreras	*The power of dynamic geometry software to facilitate the process of posing geometric conjectures and problems*	3	11
Murray	*Interactive Classroom Activities*	4	12

8:20 – 8:35 am

Name	*Title*	Room	Session
Bollinger	*Mathematical Analysis of an SIR Disease Model with Non-Constant Transmission Rate*	1	UG9
Marsh	*Using Statistical Simulation to Estimate Impacts of Tornado Outbreaks Before they Occur*	2	10
Diamantopoulos	*Visual Proofs by Animated GIFs: Revisited*	3	11
Murray	*Anti-magic Domino Squares and Rectangles*	4	12

8:40 – 8:55 am

Name	*Title*	Room	Session
Obembe	*Identifying Predictors of Treatment Response from Electrocardiogram Data*	1	UG9
Ouedraogo	*Mathematical Model of Plasmin to Treat Ischemic Stroke*	2	10
Contreras	*Modeling Problems with GeoGebra: The Picnic Problem*	3	11
Gakhar	*Stability of sparse circular coordinates*	4	12

Index of All Speakers A - R

Room refers to the Breakout Room in Zoom
UG indicates a session of presentations by undergraduates

Name (Institution)	*Session*	*Day*	*Time*	*Room*
Acre (SNU)	UG1	Fri	2:00 - 2:15 pm	1
Allen (UAPB)	UG1	Fri	1:40 - 1:55 pm	1
Beaver (WOU)	Faculty Workshop	Sat	10:10 am - 12:40 pm	2
Boersma (CWU)	Faculty Workshop	Sat	10:10 am - 12:40 pm	2
Bollinger (SWOSU)	UG9	Sat	8:20 - 8:35 am	1
Boyd (UAPB)	UG1	Fri	1:00 - 1:15 pm	1
Brock (DC)	UG9	Sat	8:00 - 8:15 am	1
Chacon (UAM)	UG2	Fri	2:00 - 2:15 pm	2
Contreras (BSU)	11	Sat	8:00 - 8:15 am	3
Contreras (BSU)	11	Sat	8:40 - 8:55 am	3
Cook (OSU)	7	Fri	2:20 - 2:35 pm	3
Cook (OSU)	3	Fri	2:00 - 2:15 pm	3
Cornelius (OBU)	UG1	Fri	2:00 - 2:15 pm	1
Davis (UAPB)	UG1	Fri	1:20 - 1:35 pm	1
Diamantopoulos (NSU)	11	Sat	8:20 - 8:35 am	3
Dorko (OSU)	3	Fri	2:00 - 2:15 pm	3
Dorko (OSU)	7	Fri	2:20 - 2:35 pm	3
Francisco (OSU)	3	Fri	1:40 - 1:55 pm	3
Fulkerson (UCO)	4	Fri	1:00 - 1:15 pm	4
Gakhar (OU)	12	Sat	8:40 - 8:55 am	4
Garrett (UAPB)	UG1	Fri	1:40 - 1:55 pm	1
Gilbert (SWOSU)	UG1	Fri	2:20 - 2:35 pm	1
Harris (UAPB)	7	Fri	3:00 - 3:15 pm	3
Hendryx (UCO)	6	Fri	3:00 - 3:15 pm	2
Ireland (OSU)	3	Fri	2:00 - 2:15 pm	3
Jackson (UAFS)	8	Fri	2:40 - 2:55 pm	4
Jaco (OSU)	3	Fri	2:00 - 2:15 pm	3
Jacob (ECU)	5	Fri	2:40 - 2:55 pm	1
Jia (ATU)	10	Sat	8:00 - 8:15 am	2
Kaman (UAF)	5	Fri	3:00 - 3:15 pm	1
Legette Jones (UALR)	6	Fri	2:20 - 2:35 pm	2
Lynam (ECU)	8	Fri	3:00 - 3:15 pm	4
Marsh (NOAA SPC)	10	Sat	8:20 - 8:35 am	2
Montiel (UAFS)	UG2	Fri	1:00 - 1:15 pm	2
Morphis (UAM)	UG2	Fri	1:20 - 1:35 pm	2
Murray (UAFS)	12	Sat	8:00 - 8:15 am	4
Murray (UAFS)	12	Sat	8:20 - 8:35 am	4
Obembe (UCO)	UG9	Sat	8:40 - 8:55 am	1
Oehrtman (OSU)	3	Fri	2:00 - 2:15 pm	3
Ouedraogo (UCO)	10	Sat	8:40 - 8:55 am	2
Raykov (UAPB)	4	Fri	2:20 - 2:35 pm	4

Index of All Speakers S - Z

Room refers to the Breakout Room in Zoom
UG indicates a session of presentations by undergraduates

Name (Institution)	*Session*	*Day*	*Time*	*Room*
Sanders (UAPB)	UG1	Fri	1:40 - 1:55 pm	1
Sellers (UMD)	Section Visitor Lecture	Fri	8:00 - 9:00 pm	Main
Smith (UAM)	UG2	Fri	1:40 - 1:55 pm	2
Tallman (OSU)	3	Fri	2:00 - 2:15 pm	3
Uhm (UAFS)	6	Fri	2:40 - 2:55 pm	2
Valdez (SWOSU)	UG9	Sat	8:20 - 8:35 am	1
Wei (OU)	4	Fri	1:40 - 1:55 pm	4
Whittlesey (CSUSM)	4	Fri	2:00 - 2:15 pm	4
Williams, E (UCO)	3	Fri	1:20 - 1:35 pm	3
Williams, S (UCO)	3	Fri	1:00 - 1:15 pm	3
Yacoubou Djima (AC)	MAA AWM Lecture	Sat	9:10 - 9:55 am	Main
Zhang (OU)	4	Fri	1:20 - 1:35 pm	4
Zoller (SNU)	7	Fri	2:40 - 2:55 pm	3
Zoller (SNU)	Student Workshop	Sat	10:10 - 11:40 am	1

Thank you for coming, and thank you to our hosts,
Henderson State University!

Future Section Meeting Hosts

2023
March 30 – April 1
East Central University
Ada, Oklahoma

2024
University of Arkansas
Fayetteville, Arkansas

2025
University of Central Oklahoma
Edmond, Oklahoma