Fall 2023 MD-DC-VA Section Meeting Abstracts

Abstracts are in chronological order. All talks are Saturday, except the workshop and banquet talk.

Workshop

Alternative Grading: Build-a-Syllabus Workshop

Justin Dunmyre (on behalf of MD-DC-VA COMMIT) , Frostburg University

Friday, 4:00-6:00 pm, Rockland Conference Room A

While you may be ready to make a change and to implement an alternative grading scheme (e.g. standards-based/specifications/mastery/un-grading), you may still wonder exactly how to do this. Or maybe you've heard enough about alternative grading to be curious about it. In this workshop we'll cover motivating considerations to assessing your students via alternative grading. We'll also cover many pitfalls that I've walked into (willingly or otherwise). We will discuss recommendations on implementing alternative grading from various sources as well as examples from our own experiences. We will also discuss guiding questions that can form the scaffolding of your own grading scheme, with dedicated workshop time to solidify the ideas of the session. My goal is for the participant to leave the workshop empowered to switch classes to an alternative grading scheme and be excited to do so.

Banquet Talk

More *Mathematics* + More *Magic* = Even More *Mathemagic*

Dave Taylor , Roanoke College

Friday, 8:00-9:00 pm, Rockland Banquet Room

When people think about magic, they tend to think about tricks, effects, routines, or illusions. In a way, it's one of the only professions or art forms where intentional deception is not only allowed but expected. When people think about mathematics, they tend to think about it being hard and it many cases "not for them." But, it's also a crucial subject that everyone needs to appreciate and understand – at least enough to be an informed person in today's world. The two overlap in an unfortunate way – too many people choose to "give up" at the first stumbling block rather than trying just a little bit more. This banquet show is not a solution to any of these problems, but rather it's a show for all of to enjoy as a celebration of what can come out of "trying just a little bit more" and being brave about stepping over that stumbling block. The show will attempt to connect mathematical principles that most can already understand or use to highlight how and why some magic tricks work. And, the show will also most definitely include routines and effects that apparently have no connection to mathematics at all. Or, maybe they do and it just won't be apparent at the time. It's a show about fun and celebrating our Section and our wonderful community.

Winning Wordle with Math

Benjamin Wilson, Stevenson University

8:50-9:10, Manning Academic Center S125

In this talk we will explore mathematically optimal strategies for playing the game Wordle. Wordle is a word-guessing game in which players have six attempts to guess a five letter word with feedback given for each guess indicating one of three possibilities for each letter of the guess: the letter is not

in the solution word at all, the letter is in the solution word but not in the correct position, or the letter is in the solution word and in the correct position. The game became extremely popular in 2021 leading to it purchase by the New York Times in 2022. It is common for individuals to have unique strategies for playing Wordle with a specific starting word or set of words and a procedure for making each guess depending on the information provided with preceding guesses. Most players strive to solve each puzzle in the fewest number of attempts. Data shows that players average a little more than 4 guesses per puzzle. We will discuss various algorithms that utilize information theory to show the theoretical best starting words and strategies for Wordle.

Trans Rights & Quantitative Justice Education

Mark Branson, Stevenson University

8:50-9:10, Manning Academic Center S137

As part of the Quantitative Justice workshops at ICERM this summer, I was part of a team which began developing a chapter on an active learning, OER approach to introductory data analysis through analysis of anti- and pro-trans legislation in recent years. I'll discuss our approach to the material, how it fits into broader efforts in quantitative justice education, and opportunities to get involved.

Calculus Misconceptions: The Power of Mathematical Thinking

YongHong L McDowell, CUNY York college

8:50-9:10, Manning Academic Center S138

Without doubt, every student made mistakes while solving calculus problems if you ask any calculus instructors. Misconception is one of the factors that contributes to student's mistakes. However, one would believe that mistakes can be detected if appropriate mathematical skills are applied, one such skill is the skill of mathematical thinking. Applying mathematical think during and after solving a problem can help students to check if their solutions made senses at all. Therefore, this project aims to analyze how mathematical thinking could be applied in solving calculus tasks to avoid making mistakes. Calculus tasks are associated with the concepts of functions, tangents, limits, and derivatives. The researcher would expect the outcomes of this project could provide undergraduate educators some implications on enhancing the skill of students' mathematical thinking so that students are able to recognize their mistakes, and hopefully they can correct them.

Pythagoras, Sabermetrics, and Fantasy Baseball

Sarah Cotter Blanset, Stevenson University

8:50-9:10, Manning Academic Center S152

Pythagorean record, developed by Bill James in the 1980s, is a simple, effective way to model the performance of a Major League Baseball team. In this talk, we compare it to another method for modeling baseball performance, one which is more complex but readily available: fantasy baseball metrics. Which common scoring systems have the strongest correlation with real-world performance? And what can they tell us about ranking individual players?

Optimizing Shut the Box

Jay Whitmon, Stevenson University

9:15-9:35, Manning Academic Center S125
(student talk)

Information theory is the scientific study of the quantification and communication of information in a system. We work with systems known as stochastic processes consisting of the different states of the system and the probabilities of moving from each state to each other state. The game Shut the Box can be modeled as a stochastic process where a state is which tiles are still up. Modeling Shut the Box as a stochastic process allows for the computation of a variety of quantities and an analysis of the optimal strategy for the game.

DEI^2: Diophantine Equations Involving Diversity, Equity, and Inclusion

Ryan Shifler, Salisbury University

9:15-9:35, Manning Academic Center S137

Data science, machine learning, AI, and big data are cool and all but have you tried number theory? I will present an application of Diophantine equations in support of DEI initiatives. This work resulted in policy changes and recommendations aimed at improving structural challenges at Salisbury University.

Building a community of mathematics students

Alexei Kolesnikov, Romy Hübler, Towson University

9:15-9:35, Manning Academic Center S138

Studies on factors that improve students' persistence in STEM majors often highlight the importance of having a sense of community. Intentional systematic efforts to foster community – the feeling of connectedness and mattering – is often the focus of Student Affairs. Traditionally, Academic Affairs and Student Affairs have operated in their distinct silos. Such silos counteract the development of sophisticated student support systems that take into account discipline-specific identities and are built on the professional expertise of faculty and staff alike. There has been a slow shift in higher education to focus on the development of the whole student, which requires educators outside and inside of the classroom to work collaboratively to create environments in which students feel like they matter and belong. But how can a mathematics department help students build a community? And how can they do so in a way that is responsive to the needs of Gen P – the new generation of students whose behaviors have been influenced by their educational and social experiences during the COVID-19 pandemic? This talk will describe several strategies that were pursued by the S-STEM team at Towson University, including a partnership with the Office of Civic Engagement and Social Responsibility.

An extension of the Pythagorean theorem, with applications

Ray Cheng, Old Dominion University

9:15-9:35, Manning Academic Center S152

We'll review the Pythagorean theorem for inner product spaces, and think about how orthogonality might be defined for normed spaces without an inner product. We'll see a version of the Pythagorean theorem for certain normed spaces, where orthogonality is in terms of an extremal condition, explore some of its consequences.

Invited address

Community and Belonging in Mathematics

Deanna Haunsperger , Carleton College

9:55-10:55, Manning Academic Center S124 (SoLVE Center)

How can building communities in mathematics help in our ongoing quest to make mathematics more inclusive? From social psychologists we can learn the importance of individuals feeling accepted, valued, and legitimate within their community – the importance of a sense of belonging. From successful communities we can learn the power, in the form of resilience and perseverance, that their members enjoy. Armed with this information, we can create communities to support members of underrepresented groups in mathematics.

The Epsilon of Math Problem Calendar

Dan Kalman, American University (ret)

11:05-11:25, Manning Academic Center S125

Last November I found the 2023 Daily Epsilon of Math wall calendar on the AMS website and took advantage of the Preview Materials link to download April, July, and September. This lead to many shocking, interesting, and amusing surprises. For one thing, DEoM calendars have been published for at least six years, though the AMS only published the most recent version. For another, it is helpful to read the back cover of the calendar before you attempt any of the problems. In my view these calendars and associated material have a lot to offer MAA members. In this session I will offer some highlights (and lowlights) of my experiences connected with the calendar.

Modeling Resistive Electric Networks using Algebraic Graph Theory

Caroline Melles, United States Naval Academy

11:05-11:25, Manning Academic Center S136

We use algebraic graph theory to describe an electric network of resistors. The network is modeled by a weighted graph with boundary. Current may enter or leave the network only at boundary vertices. The weight of each edge is the reciprocal of its resistance, also called the conductance. Kirchhoff's laws for the network can be written concisely in terms of the incidence matrix of the graph and a diagonal matrix of conductances. We describe the relationships among current flow, voltage drops along edges, and electric potential functions on vertices in terms of simple matrix equations. The electric potential functions must be harmonic at all interior (non-boundary) vertices. We conclude with some preliminary results about graph morphisms between resistive electric networks (joint work with David Joyner).

Strategies for Advancing Academic Success in a NSF S-STEM Program at Shepherd University

Qing Wang, Amy Dewitt, Weidong Liao, Karen Adams, Reza Mirdamadi, Emily Gross, Shepherd University

11:05-11:25, Manning Academic Center S137

The Track II NSF S-STEM Program in the CME Department at Shepherd University started in October 2021 and has sponsored 17 scholars majoring in computer science, mathematics, data analytics, or engineering. One of the objectives of the program is to advance student success in STEM fields by providing financial, academic, and social supports to improve retention and graduation

rates. Major activities, outcomes, and strategies to improve student academic performance will be discussed in this presentation. The program has been supported by the NSF S-STEM grant (award No. 2130267).

Cross-curricular assignments-Statistics

Alice Petillo, Marymount University
11:05-11:25, Manning Academic Center S138

This session is intended for faculty members and focuses on introducing sample cross-curricular assignments that can be incorporated into statistics courses for students. These assignments can be completed independently outside of class time. They are also easily modified. The goal is to equip faculty to encourage students to connect statistical concepts with their individual academic disciplines or areas of interest. Attendees will receive assignment directions, sample student responses, and a detailed rubric to assist them in implementing these assignments in their courses.

Pythagorean Triples

Deepa Ramakrishnan, Frederick Community College
11:05-11:25, Manning Academic Center S152

In this talk, triple arithmetic will be demonstrated, and will be performed on Pythagorean triples to yield formulas for double angle identities.

Modeling Antibody Levels Post SARS-CoV-2 Vaccination

Zihao Zhao, Johns Hopkins University
11:30-11:50, Manning Academic Center S125
(student talk)

We conducted an analysis of antibody levels in individuals post severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccination, utilizing a publicly available dataset of over 70,000 samples. In order to characterize immune responses, as evidenced by the levels of antibodies present, time-independent and time-dependent probabilistic models were proposed. The models offer insight into the variability of immune responses in a population. In particular, the time-dependent model characterizes the dynamics of antibody levels, highlighting patterns of increase, peak, and decline. The publicly available data was originally sorted into four subgroups based on antibody response; we applied statistical metrics to measure their dissimilarity. The models may aid in decision-making processes related to managing and mitigating the impacts of coronavirus disease of 2019 (COVID-19).

Teaching Mathematics using Blended Synchronous Learning

Maggie Habeeb, PennWest California
11:30-11:50, Manning Academic Center S137

With the advances in technology, many college courses will be delivered in various formats including traditional, hybrid, synchronous online, asynchronous online and blended synchronous format. In this presentation, I will discuss my experience teaching a college level mathematics course in a blended synchronous format. The various challenges of teaching in this format will be discusses and actions to address these challenges will be proposed.

A Mixture Theory Approach for Modeling Non-Newtonian Fluid Flow in Deformable Porous Media

Asif Mahmood, University of Virginia

11:30-11:50, Manning Academic Center S138

We present a mathematical model of non-Newtonian flow-induced deformation in a soft biological tissue. The tissue is modeled as a deformable porous material where the injected power law fluid is absorbed by the tissue at a rate which is proportional to the local pressure. A spherical cavity embedded in an infinite porous medium is used to find the fluid pressure and solid displacement in the tissue as a function of radial distance and time. The governing nonlinear equations are solved numerically to highlight the effects of various emerging parameters.

Pythagorean Triples and Generalized Fibonacci Numbers

Jathan Austin, Salisbury University

11:30-11:50, Manning Academic Center S152

There are many interesting connections between Pythagorean triples and the Fibonacci sequence. In this talk, we will explore a few (relatively new) connections that arise in the context of Pythagorean triple preserving matrices.

Invited address

Putting the Differential Back in Differential Calculus

Eugene Boman , Pennsylvania State University, Harrisburg

2:20-3:20, Manning Academic Center S124 (SoLVE Center)

The definition of the limit was the culmination of a 200 year effort to put a solid logical foundation under the Calculus invented by Leibniz and Newton. It is highly abstract, very subtle, and completely rigorous, but it disconnected from the previous mathematical experience of a beginning Calculus student. It is poor pedagogy to start the course with such an esoteric topic and I have long been frustrated with this non-intuitive approach to Calculus. But Calculus did not begin this way. Leibniz and Newton's invention was originally based on the less-than-rigorous, but highly intuitive notion of the differential (Leibniz) or an infinitesimal moment of time (Newton). I have long contended that differentials could provide a much better starting point for a student beginning a modern course in Calculus. My friend and colleague Robert Rogers (SUNY, Fredonia) and I have written an OER Calculus textbook supporting this approach. In this talk I will describe our goals for the book, how our text attains those goals, and what we learned in the process of writing it.

On the local limit theorems for linear sequences of lower psi-mixing Markov chains

Na Zhang, Towson University

3:30-3:50, Manning Academic Center S125

In this paper, we investigate the local limit theorem for partial sums of linear sequences of the form $X_j = \sum_{i\in\mathbb{Z}} a_i\xi_{j-i}$. Here $(a_i)_{i\in\mathbb{Z}}$ is a sequence of constants satisfying $\sum_{i\in\mathbb{Z}} a_i^2 < \infty$ and $(\xi_i)_{i\in\mathbb{Z}}$ are functions of a stationary Markov chain, centered at zero and have finite second moment. The Markov chain is assumed to satisfy the one-sided lower psi-mixing condition.

Enhancing STEM Enrollment, Retention, and Graduation: Insights and Strategies for Student Success

Raina Burton, Johnna Smith, Shepherd University
3:30-3:50, Manning Academic Center S137
(student talk)

One of the national education priorities is increasing STEM enrollment and persistence. To better understand this goal, we synthesized over 20 findings related to STEM success and its measurement with the aim of enhancing student recruitment, retention, and graduation rates. We analyzed surveys focusing on various student categories, including underrepresented minorities (URMs), high-achievers, low-income individuals, first-generation students, community college transfers, and gender diversity, among others. This comprehensive examination provided us with valuable insights into how to best assist students and make the STEM pathway more appealing. Throughout our research, a consistent pattern emerged: when programs improved students' self-efficacy and fostered a sense of belonging, the students were more likely to excel and persist in STEM. Achieving these outcomes can be accomplished through undergraduate research opportunities, networking, seminars, summer bridge programs, field trips, workshops, and more. Once students gain confidence in their abilities and feel a strong connection to the school environment, they are better equipped to succeed and persevere on a STEM pathway. The project was supported by the Summer Undergraduate Research Experience Grant (SOARS) from the West Virginia Higher Education Policy Commission Division of Science and Research and the NSF S-STEM Grant (award No. DUE-2130267).

Lambert W function and its Applications

Ming Fang, Norfolk State University
3:30-3:50, Manning Academic Center S138

The Lambert W-function is the solution to $x = W(x)e^{W(x)}$. In this talk, we will present two examples, one in pure math and one in biochemistry, to solve equations in which the unknown quantity occurs both in the base and in the exponent, or both inside and outside of a logarithm.

Compassionate Teaching

Amy Tucker, Stevenson University
3:30-3:50, Manning Academic Center S152

Compassion has a place in all classrooms. Creating a compassionate space in education benefits both students and instructors. This talk will discuss the scope of passionate teaching and how to implement it into a math classroom.