

Mathematical Association of America
MD-DC-VA Section, November 7, 2020
Virtual
Abstracts

Abstracts for the invited addresses are listed first, in chronological order, followed by faculty and student abstracts, alphabetized by submitting presenter's last name. Student presentation abstracts follow.

Invited Addresses

MORNING ADDRESS

Kristen Boyle, Longwood University

Complete Leibniz Algebras

9:00 AM, Zoom Room 1

Leibniz algebras are certain generalizations of Lie algebras. It is natural to generalize concepts in Lie algebras to Leibniz algebras and investigate whether the corresponding results still hold. In some cases, the generalizations of definitions and theorems extend directly from those established for Lie algebras. In other cases, modifications must be made to ensure the signature results from Lie theory will carry over to Leibniz algebras. In this talk, we will consider examples of Leibniz algebras which are not Lie algebras. We will discuss the trial-and-error process used to determine a definition for completeness in Leibniz algebras; and finally, we will introduce the notion of complete Leibniz algebras as a generalization of complete Lie algebras.

NOON ADDRESS

Anthony J. Kearsley, National Institute of Standards and Technology (NIST)

A Survey of Applied Mathematics Applications in Metrology at NIST

12:05 PM, Zoom Room 1

Estimating optimal parameters, locating desirable regimes and proposing best practices are issues that arise often in measurement science applications. In this talk, a survey of research at NIST will be presented, each of which will demonstrate the need for optimization. The examples will draw from current research at NIST in disparate fields.

AFTERNOON ADDRESS

Gretchen Matthews, Virginia Tech

The power of polynomials: polynomials in distributed storage

3:05 PM, Zoom Room 1

Polynomials over finite fields have been employed to protect information in a variety of ways, starting with Reed-Solomon codes in the 1960s. They are responsible for error-correction in CDs, DVDs, and QR codes, among many other behind-the-scenes uses. The data deluge of the past decade has prompted a new application. In this talk, we consider the use of polynomials in distributed storage.

Contributed Faculty Papers by Author

Jathan Austin, Salisbury University

NFL Betting in a Math For Liberal Arts Course

10:05 AM, Zoom Room 3

In this talk, we will discuss aspects of betting on the NFL that are suitable for students of varying mathematical backgrounds. In particular, ways of using this topic in a math for liberal arts course will be highlighted.

Content Area: Mathematics Education

Recommended for Students: Yes

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Michael Baron, American University
Estimation of under-reported epidemic counts
10:55 AM, Zoom Room 1

The officially reported COVID-19 daily counts of infected, recovered, and perished people are underestimated. It is widely known that only a portion of infected individuals receives professional coronavirus testing. Even those who have been tested, confirmed, and then recovered, not all recoveries are reported. Furthermore, the proportion of unobserved and under-observed counts varies by territory and changes in time, because of different and changing diagnostics and reporting standards.

We propose and develop a stochastic model that includes untested individuals and unobserved COVID-19 recoveries and casualties. The model that we call SICROUD (Susceptible - Infected - Confirmed - Recovered - Observed - Unobserved - Died) generalizes the classical SIR epidemic model, extending it with additional compartments. Its main parameters are the infection rate, the testing rate, the recovery rate, the mortality rate, and the reporting rate, which may vary continuously in time. The proposed Bayesian algorithm uses observed counts to estimate the model parameters and unobserved counts dynamically, updating the estimates with new data on daily basis.

The algorithm is applied to evaluate the trends, produce forecasts, and compare epidemic situation in different world countries and US states.

Content Area: Mathematical statistics, Bayesian modeling, Epidemiology
Recommended for Students: Yes

Lihua Chen, James Madison University
Panayotis Giannakouros, James Madison University
Estimating Survival Functions to Account for Model Uncertainty: An Information -Theoretic Approach
2:40 PM, Zoom Room 1

The global Covid-19 pandemic has raised the profile of survival analysis. At the same time, the public health context of the pandemic makes the problem of model uncertainty easy to see. We develop an approach to estimating survival functions through model combining to account for model uncertainty. This approach draws on information theory with the property that up to an additive penalty term of order $1/n$, the combined estimator performs as well as the best estimator in the model list. We find that survival analysis in the presence of model uncertainty is a fruitful area of study that is topical and has theoretical issues still open to be explored.

Content Area: statistics
Recommended for Students: Yes

Kubilay Dagtoros, Norfolk State University
Sujan Pant, Norfolk State University
Counting number of walks: shift transformation approach to Ballot theorem
1:50 PM, Zoom Room 2

We will explore another approach to the classical Ballot theorem using a shift transform approach, and construct a recursive formula for counting number of walks between two obstacles at a predetermined stop location.

Content Area: Self-avoiding walk, probability theory
Recommended for Students: Yes

Greg Dresden, Washington & Lee University
Centralizers and Normalizers of linear fractional transforms
10:05 AM, Zoom Room 2

We consider simple linear fractional transforms like $(1+x)/(1-x)$ and $(Ax+B)/x$ and we ask: what are their centralizers and normalizers?

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Content Area: algebra

Recommended for Students: Yes

Ming Fang, Norfolk State University

Numerical Methods in Agriculture Risk Managements

10:30 AM, Zoom Room 1

In this talk we will use Monte Carlo simulation and Newton's method to study how price support program in agriculture will affect consumer prices, farm prices, government expenditures, price variability for consumers and farmers, etc., for different price support levels.

Content Area: Computational Sciences

Recommended for Students: Yes

Sam Ferguson, Metron, Inc.

Obamacare and a Fix for the IRS iteration

1:50 PM, Zoom Room 1

Since 2010, it has been an unsolved math problem to determine the amount of Obamacare benefits in general. This is because, for Uber drivers and other self-employed people, there is a circular relationship in the Internal Revenue Code. In 2014, the IRS created a fixed point iteration as an attempted resolution. In this talk, I show how the IRS iteration fails in general, how an elementary idea from real analysis fixes the problem, how I found out about the problem from an Uber driver, and how the IRS came to agree with my solution.

A three minute video by Time's film crew on this work can be found at:

<https://twitter.com/money/status/986008838452133890>

A copy of Money's article on this work can be found at:

<https://finance.yahoo.com/news/27-old-math-whiz-uber-100011780.html>

A preprint on this work can be found at:

<https://arxiv.org/abs/2008.03355>

Content Area: Calculus, Real Analysis

Recommended for Students: Yes

Spencer Hamblen, McDaniel College

Deciphering Mastery-Based Grades

2:15 PM, Zoom Room 4

Getting student buy-in is crucial for a successful course in any format. In mastery-based grading courses with many small assignments, the way grades are tracked and displayed can make it difficult for students to get a clear picture of the grading system, reducing student buy-in. We will investigate alternate methods for tracking and displaying students' scores, and report on previous successes and failures.

Content Area: Teaching with Inquiry

Recommended for Students: Yes

ILHAN M. IZMIRLI, George Mason University

Group Theoretic Representation of Just Intonation

10:30 AM, Zoom Room 2

In this paper, we will first briefly discuss the mathematics of various tuning systems and show that all possible musical intervals in just intonation can be represented by the abelian group $\{2^k 3^m 5^n \mid k, m, n \in \mathbb{Z}\}$

Content Area: General

Recommended for Students: Yes

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Lydia Kennedy, Virginia Wesleyan University

Self-intersecting geodesics on cones with small cone angle

2:15 PM, Zoom Room 2

Geodesics on non-Euclidean surfaces can have different properties than straight lines in Euclidean space. Straight lines in Euclidean space are never self-intersecting. However, on cones with small cone angles, geodesics can self-intersect. We will explore when self-intersection occurs and how many self-intersections are possible.

Content Area: Non-Euclidean Geometry

Recommended for Students: Yes

Amy Ksir, US Naval Academy

Inquiry and Equity in 2020

1:50 PM, Zoom Room 4

Teaching with inquiry has many affordances for promoting equity, but it also has the potential to highlight student differences and reinforce power differentials. Teaching online or in a hybrid or socially distanced classroom introduces even more opportunities and challenges with regard to equity. In this session, we will discuss some of the ways we have used inquiry and our special 2020 circumstances to promote equity. We will also share our observations of inequity, challenges, and plans for addressing them.

Content Area: Teaching with Inquiry

Recommended for Students: Yes

Jane Long, Stephen F. Austin State University

One Model for a Successful Capstone Course for Mathematics Majors

10:55 AM, Zoom Room 4

For the past several 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.

Content Area: Teaching with Inquiry

Recommended for Students: Yes

Daniel Majcherek, Liberty University

Getting Started with LaTeX

2:40 PM, Zoom Room 3

This talk is designed for students or other individuals who have little to no experience with LaTeX, but are interested in learning about it. LaTeX is a typesetting system that has become a standard in the sciences. It can be used for constructing documents to be published, writing a quiz or exam for your students, neatly preserving class notes, and much more! For those who would like to learn the basics of LaTeX and how to set it up without having to devote much time to the process, this will be a great place to start.

Content Area: LaTeX

Recommended for Students: Yes

MD-DC-VA IBL Consortium Fall Business Meeting

10:30 AM, Zoom Room 4

All current and prospective members of the MD-DC-VA IBL Consortium are welcome to attend our Fall Business Meeting. A major topic of discussion will be a name change to the national organization and a corresponding name change for our community, as well as plans for future events. We look forward to seeing you there!

Content Area: Teaching with Inquiry

Recommended for Students: No

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Emily Meehan, Gallaudet University

What does teaching with inquiry look like?

10:05 AM, Zoom Room 4

Have you heard the term “IBL” and are not sure what that means? Or maybe it feels totally overwhelming to change the way you’re running your classroom, and so it seems like IBL isn’t for you? The term IBL (Inquiry Based Learning) often brings up specific images of what is happening in a classroom, but inquiry can be used in a wide variety of classroom structures and class types. In this talk, we share some suggestions of how to include inquiry in any of your classrooms in both small and major ways.

Content Area: Teaching with Inquiry

Recommended for Students: Yes

Caroline Melles, United States Naval Academy

Matrix methods for harmonic graph morphisms

2:15 PM, Zoom Room 1

In a 2009 paper, Baker and Norine described harmonic morphisms of graphs as an analogue of holomorphic maps between Riemann surfaces. We give a matrix identity characterizing harmonic morphisms of graphs in terms of their adjacency matrices and a vertex map matrix. This identity makes it easy to do computer experiments. Formulating the concept of harmonic morphisms in terms of matrices also makes it accessible to undergraduates. This is joint work with David Joyner.

Content Area: Graph theory

Recommended for Students: Yes

Cherng-tiao Perng, Norfolk State University

On Perspective Triangles Arising from the Apollonian-Soddy Configuration

10:55 AM, Zoom Room 3

In this talk, I will present solutions to the problems proposed on April 22, 2018 by Dao Thanh Oai regarding Apollonian-Soddy triangles.

Content Area: Geometry and Sequences

Recommended for Students: Yes

Jenny Polm, John Tyler Community College

Sharon Emerson-Stonnell, Longwood University

Randall Helmstutler, University of Mary Washington

Reimagining Virginia High School Mathematics

2:15 PM, Zoom Room 3

The Virginia Mathematics Pathways Initiative (VMPI) is a joint initiative between the Virginia Department of Education, the State Council of Higher Education for Virginia, and the Virginia Community College System. VMPI goals include building mathematics pathways to improve student success for all high school students through the creation of new high school mathematics courses focused on data science, mathematical modeling, geometry and design, and more. Come learn about the collaborative work already underway and how college faculty and administrators will be crucial to the success of this project.

Content Area: Mathematics Education, Mathematics Pathways

Recommended for Students: Yes

Karin R Saoub, Roanoke College

Discrete Math: Final Portfolio versus Final Exam

1:50 PM, Zoom Room 3

What is the best way to evaluate student learning? In mathematics, we often rely on the standard test, whether an in-class timed exam or more open take-home format. But in a course that focuses on the student’s ability to write a mathematical proof, choose the correct technique, and understand the basis for

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proofs, the standard test model does not align with these goals. Here we describe the utilization of a Final Portfolio in a Discrete Mathematics course, including a discussion of its structure, benefits and challenges to evaluating student learning, and student perception of this assessment tool.

Content Area: course design/assessment tools
Recommended for Students: No

Ruchita Sharma, Morgan State University
Study of Vector Machine Classifiers and Application
10:05 AM, Zoom Room 1

In this work, we briefly describe the Supervised and Unsupervised Algorithms for Machine Learning. Then, we investigate Support Vector Machine in depth, study the mathematical algorithm and kernels. Finally, we provide an application of Support Vector Machine in classification of 176 countries affected by Coronavirus utilizing the number of people affected and deceased due to the virus.

Content Area: Machine Learning
Recommended for Students: Yes

Andrew Volk, Liberty University
Zipf's Law of Baseball Career Leaderboards
10:30 AM, Zoom Room 3

Zipf's Law was originally applied to linguistics and described the mathematical relationship between a word's usage rank and the frequency of usage. Mandelbrot further expanded the laws to go beyond common language and it has since been applied to diverse data sets. This talk discusses the history of Zipf's law and seeks to confirm or reject its application to baseball career leaderboards in wins, strikeouts, home runs, and more.

Content Area: Statistics, Curiosity, Baseball
Recommended for Students: Yes

Marshall Whittlesey, California State University San Marcos
A course in spherical geometry for undergraduates
2:40 PM, Zoom Room 2

We explore topics for a course in classical spherical geometry for mathematics majors. We introduce an axiomatic system for spherical geometry and learn how to use it to build the subject. We emphasize applications of the subject to the earth, astronomy and crystallography. Another possible topic to emphasize is the use of quaternions to prove theorems for spherical triangles. This approach to spherical geometry is done in the speaker's book "Spherical Geometry and its Applications," with CRC Press (2020).

Content Area: Geometry
Recommended for Students: Yes

Cassie Williams, James Madison University
Using Collaborative Whiteboards in Online Classes to Promote Student Engagement
2:40 PM, Zoom Room 4

Even if your online classes are synchronous, it can be tricky to finding ways to engage students in the same ways we did in person, not least because it can be difficult to replicate experiences like having students working at a physical whiteboard. In this talk, I will share information about online collaborative whiteboard options, how I am using them in my online courses, and how it's working.

Content Area: Teaching with Inquiry
Recommended for Students: Yes

Student Abstracts by Author

Nikita Patel, Virginia Tech

Isabel Byrne, Virginia Tech

Failed Power Domination for Families of Graphs

10:55 AM, Zoom Room 2

The power domination number of a graph, introduced by Haynes et al in 2002, is the minimum number of vertices (which model phasor management units, or PMUs) required to monitor the graph (or network). PMUs are vital to a number of applications including power grids and GPS navigation. In general, not every configuration of this minimal number of vertices will monitor the network, so placement is crucial. In this presentation, we consider a new graph invariant called the failed power domination number of a graph G , denoted $FP(G)$ by Glasser et al in 2019. Any set of nodes whose cardinality is greater than $FP(G)$ will dominate the graph regardless of which vertices are selected. The failed power domination number also allows us to consider PMU or node failure. We consider three families of graphs: grids, cylinders, and tori. In each case, we provide bounds for the failed power domination number.