Spring 2026 MD-DC-VA Section Meeting Abstracts

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

Workshop

Getting Started with PreTeXt for Accessible, Interactive Course Materials

Geoff Cox , Virginia Military Institute

4:00-6:00, H115L

PreTeXt is an open-source authoring system designed for creating high-quality mathematical and STEM materials in multiple formats (including web and PDF) from a single source. In this beginner-friendly, hands-on workshop, participants will learn what PreTeXt is, how a typical authoring workflow is organized, and how to get from "first file" to published output quickly. We'll walk through the basic structure of a PreTeXt project.

Attendees will leave with a clear setup path, a minimal working example they can adapt for their own courses, and a roadmap for adding interactive elements, managing larger projects, and collaborating on open textbooks. No prior PreTeXt experience is assumed.

Banquet Talk

Bayes' Theorem – Making Rational Decisions in the Face of Uncertainty

Allen Butler , Daniel H. Wagner Associates, Inc.

8:00-9:00, H115L

A statement of Bayes' Theorem (aka Bayes' Rule) can be written very succinctly, but this belies its far-reaching consequences. In this talk, I will provide a little of the history behind Bayes' Theorem, a derivation of the mathematical basis in probabilistic terms, and a description of the less formal basis where it is viewed as a form of evidential or inferential reasoning. I will illustrate the utility of Bayes' Theorem by describing applications from the work of my company, Daniel H. Wagner Associates, Inc. One of these resulted in the location and recovery of the "Ship of Gold," the SS Central America, a side-wheel steamer carrying nearly six hundred passengers returning from the California Gold Rush, which sank in a hurricane two hundred miles off the Carolina coast in September 1857.

Running Undergraduate Research at Smaller Universities

Kevin Sinclair, Cindy Schneider, Shenandoah University

8:20-8:40, H204

Running undergraduate research at a smaller university can create roadblocks ranging from lack of faculty, funding, and student excitement. This talk will outline the triumphs and tribulations we have faced in conducting research with undergraduates at our university. We will go through anticipated timelines and research expectations our students experience and how we collaborate with other departments. The talk will finish with a group discussion for others to share their own experiences.

Normal Mixture Density Estimation for Major US Stocks: A Four-Year Empirical Study

Nathan Carter, Hasan Hamdan, James Madison University

8:20-8:40, H205

This study investigates the density estimation of the Continuously Compounded Returns (CCR) for five major U.S. stocks over a four-year period (April 2022 – April 2026). Given that financial returns often exhibit non-normality, we employ Variance Mixtures of Normals to capture the underlying market regimes of the CCR. Using approximately 1,000 daily closing price observations, we compare three estimation frameworks: a Bayesian approach, the Expectation-Maximization (EM) algorithm, and the UNMIX model. The performance and fit of these models are evaluated and compared using Chi-square tests and other goodness-of-fit metrics. Our findings aim to identify the most robust modeling approach for better capturing both the body and the tails of the CCR density.

Variational model of shape memory alloys

Audrey Morrisette, Oleksandr Misiats, Virginia Commonwealth University

8:20-8:40, H206

In this talk we will present a one dimensional functional, which is used in modeling materials with memory effects. We will start with a demonstration of such shape memory alloy. The patterns, formed in it, minimize certain nonconvex, singularly perturbed energy functional. By means of sharply matching upper and lower bounds, we show that this functional admits a unique, explicit minimizer - a rare finding in nonconvex minimization problems of this type!

Type C Affine Curve Neighborhoods

Ben Goodberry, Salisbury University

8:20-8:40, H210

Buch and Mihalcea described an explicit construction of the curve neighborhood of a Schubert variety. This was done combinatorially using Hecke products with a recurrence relation, and applied to all semisimple Lie types. Aslan extended this to work similarly in affine type A. We follow a similar path to Aslan's work to describe curve neighborhoods in affine type C. This is joint work with Ryan Shifler.

Spreading the Love of Mathematics

Minah Oh, James Madison University

8:45-9:05, H204

We often meet students that say that they don't like math. If you hear their stories, however, it is more of a story about how they felt frustrated when they were not able to understand the math that they had to learn. No one likes the feeling of being confused in the classroom. As educators of mathematics, it is our duty to teach mathematics, whatever level it is, in a way that the students can understand and follow. Once we can do this, with carefully selected fascinating topics, we can truly share the beauty and importance of mathematics to a broad audience. In this talk, I will talk about how I was able to spark students' interest in mathematics in my courses of various levels from General Education classes for non-STEM majors to upper-level math courses such as Numerical Linear Algebra. I will also talk about how mathematics and programming can be used together to accomplish this goal.

A Case for Quantum Computing in Math Departments

Ryan Shifler, Salisbury University

8:45-9:05, H205

Quantum computing is fundamentally a mathematical subject, grounded in linear algebra, probability, and abstraction rather than physics hardware. This talk argues that quantum computing fits naturally within the mathematics curriculum, where concepts such as vector spaces, tensor products, and unitary transformations take on new computational meaning. Drawing on my experience teaching a quantum computing course this semester, I will highlight how the subject enriches core mathematical training while preparing students for a rapidly emerging interdisciplinary field.

Using Taylor polynomials more meaningfully

Bob Sachs, George Mason University

8:45-9:05, H206

In a typical second semester calculus course, Taylor polynomials can be introduced earlier and used to understand several topics with greater depth and understanding. We will illustrate one example of this and discuss other possibilities if time permits.

The structure of permutations corresponding to the Hopf link

Efosa Owie, Towson University

8:45-9:05, H210

(student talk)

The cycle diagrams of permutations resemble grid diagrams used to depict knots and links in topology. By drawing the cycle diagram of a permutation and then considering that diagram to be a grid diagram instead we can associate a knot to any permutation. Previous work has enumerated permutations that correspond to unknots (or unlinks). We investigate permutations whose cycle diagrams correspond to Hopf links and trefoil knots. It suffices to characterize those permutations which are derangement ($\sigma(i) \neq i$ for any i) and have no points on the off diagonal ($|\sigma(i) - i| \neq 1$ for all i, $\sigma(1) \neq n$ and $\sigma(n) \neq 1$). Using ideas motivated by Seifert's algorithm in topology, a method to obtain the boundary of a connected, oriented surface by smoothing crossings and connecting the resulting loops with bands, we are able to characterize all the permutations that are associated to a Hopf link.

Stealth Outreach: Granny Life and AutoScarf

Laura Taalman, James Madison University

9:10-9:30, H204

In this talk we will discuss two math/art/code projects that use crochet as a medium for "stealth outreach" to nontraditional audiences. The recently completed "Granny Life" project engaged over 100 crafters in a community math/art project that is currently in an exhibition in Paris, France. Our new project "AutoScarf" uses customized 1D cellular automata to create self-generating scarf patterns that participants around the world will use to generate one million hand-crafted algorithmic stitches. At the end of the talk we will provide an open invitation to participate in this new project.

Matrix Binomial Theorem with an AI co-author
Dan Kalman, American University (Ret)
9:10-9:30, H205

Math Theme: Let A and B be $m \times m$ matrices and let $n > 1$ be given. Then $AB = BA$ implies $(A + B)^n$ can be expressed using the binomial theorem. The implication is not bidirectional. That is, the binomial expansion may be valid even when AB is not equal to BA. Families of examples will be presented.

Methodology Theme: investigated collaboratively with the Google AI agent. The agent carried out finicky algebra (mostly correctly), composed summaries of discussions as latex documents with no coding errors, and contributed algebraic and logical insights the human author missed.

Some Parametrizations and Linear Transformations of Integer Triangles
Jathan Austin, Salisbury University
9:10-9:30, H206

In this talk, we will present a way to parametrize all integer triangles with a given rational cosine. We will also touch on approaches that already exist in the literature. Our parametrization gives rise to linear transformations that can be used to generate integer triangles with a given rational cosine.

Geometry: Beyond Euclid
Jennifer Bergner, Salisbury University
9:10-9:30, H210

What *is* geometry? Where is it in the mathematics curriculum? Is it more than proof/rigor? Poets and politicians alike have reflected upon the geometry as it is laid out in Book 1 of Euclid's Elements with awe and appreciation, while general consensus can vary widely. In this session we aim to put a historical lens on geometry and its place in the K-13 curriculum (and beyond) and give participants a chance to share their thoughts on how, when and if it should be in the mathematics experiences of high school and college students.

Invited Address
Pattern Avoidance in Restricted Permutations
Opel Jones , John's Hopkins University Applied Physics Laboratory
9:45-10:45, H115L

In 1974 Dumont found two types of permutations are counted by the same sequence. The first type is a permutation in which each even entry is followed by a smaller entry, and each odd entry is followed by a larger entry, or ends the permutation. The second type is a permutation wherein if an entry is a deficiency, it must be even, and if an entry is an exceedance or a fixed point, it must be odd. These are now known as Dumont permutations of the first and second kinds. There are two other types of permutations which are also counted by the same sequence, known as Dumont permutations of the third and fourth kinds. In this talk we will discuss several enumerations of restricted Dumont permutations, that is Dumont permutations avoiding certain patterns. We will also briefly discuss their proofs which involve methods using induction, block decomposition, Dyck paths, and generating functions. We will conclude with a conjecture that the patterns 2143 and

3421 are indeed Wilf-equivalent on Dumont permutations of the first kind.

Predicting Positive Student Emotional Association with Coursework - Comparing Regression Models

Kenneth Cassada, Shenandoah University
2:35-2:55, H204
(student talk)

Generalized Linear Models offer a cohesive, diverse and easy to use framework for statistical modeling. Unfortunately, they lack a continuous finite domain probability distribution. In this project I compare two plausible models: beta regression(a flexible regression model that deviates from the GLM framework) and binomial regression(a more rigid, but still plausible generalized linear model). I collected data by surveying 25 general education classrooms in Shenandoah University to find predictors of various positive and negative emotions. The survey asked questions relating to motivation, experience, and confidence which were used alongside some classroom information like subject and time as features to predict emotions. Correlations were modeled using beta regression and binomial regression and the two models were compared.

VMI Baseball Pitching Analytics

Andrew Kohan, Virginia Military Institute
2:35-2:55, H205
(student talk)

The study of baseball through data and statistical analysis has been an ever-increasing phenomenon. It stems from the urge to increase knowledge about strategy and player effectiveness. This work aims to investigate three distinct states of the game and report on the trends that appear during them and what they mean for the Virginia Military Institute's baseball team and the sport as a whole. Specifically, it will address the noticeable trends in VMI pitchers in terms of their predictability for pitch type and pitch location, trends in the signs of an expected run value when modeled by physical and game-state variables, and how batting physics relate to outage percentage.

A characterization of the Seidel spectrum for switching classes of graphs

Isabel Walder, St. Mary's College of Maryland
2:35-2:55, H206
(student talk)

Let $G = (V, E)$ be a graph with adjacency matrix $A(G)$ and Seidel matrix $S(G) = J - 2A(G) - I$. We examine the characteristic polynomial, $\phi(S(G))$, of the Seidel matrix. We prove a general form for the coefficients of some terms of $\phi(S(G))$ for all graphs on n vertices. We also prove a general form for the Seidel characteristic polynomial for the complete bipartite switching class and its complement. ***Arc Length and Surface Area: Where Calculus Techniques Meet***

History
David W Stephens, The Bryn Mawr School
2:35-2:55, H210

Students in AP Calculus BC encounter these topics as applications of integration, and it is helpful pedagogically for them to see the connections between the calculus techniques and the ideas of measurement that they learned in geometry and algebra classes. But it is even more fascinating for them to revisit ruler measurement, the distance formula, and the Pythagorean theorem, adding the very old theorems of Pappus to make the surface areas in calculus make sense. Then the very contemporary ideas and skills of chaos theory and fractals with their new way of considering measurement of coastlines together with the technology methods of the Gaussian quadrature in the TI calculators (for fnInt) are added to create a rich blend of methods, history, and understanding of advanced calculus techniques. This is a very powerful couple of days in a high school classroom with eager young minds.

Should Education Programs have Foreign Language Requirements?
Erin Boyd, Shenandoah University
3:00-3:20, H204
(student talk)

Every year the population for English Learner (EL) students increases in K-12 classrooms. This has raised questions about how teacher preparation programs can better equip future educators to support linguistically diverse learners in mathematics classrooms. This study examines whether education majors and non-education majors support requiring education majors to complete at least two Spanish courses as part of their teacher preparation. Spanish is the second largest language used in the United States, which means a large portion of EL students' primary language is Spanish. Using a cross sectional survey design, undergraduate students will be recruited, surveyed, and categorized as education majors and non-education majors. Participants will rate their level of support using a six point Likert scale. A two sample t-test will be conducted to determine whether a statistically significant difference exists between the mean levels of support reported by the two groups.

Computer Vision for Freshwater Macro-invertebrate Identification for Water Quality Monitoring
Wilson Beima, Shenadoah University
3:00-3:20, H205
(student talk)

Testing water quality is critical to measuring environmental change and ensuring the health of an ecosystem. With the necessity of expensive equipment to measure water quality directly, environmental stewards implement citizen-led macroinvertebrate bioassessment programs, like Virginia Save-Our-Streams as a "canary in the coal mine" to identify environmental stressors in aquatic systems. The proportion of mayflies, caddisflies and stoneflies in a freshwater ecosystem has been shown to be an effective proxy for water quality. But the process of identifying these species requires extensive training and time investment. For this reason we have developed an image-based convolutional neural network (CNN) capable of classifying the three taxa from field photographs, eliminating the need for expert identification. Our initial results demonstrate promising classification accuracy across the three taxa, laying the groundwork for a deployable field tool.

Elliptic Curve Key Exchanges for Classical Ciphers

Connor Hill, Shenandoah University

3:00-3:20, H206

(student talk)

Classical ciphers are a symmetric form of encryption, meaning they require the same key to be used for encryption and decryption. The Key-Sharing Problem is the challenge of securely sending and receiving these keys in a public channel. We consider methods of overcoming this problem for several ciphers by making use of Elliptic Curves (ECs). We then examine implementations of the resulting asymmetric key-exchange algorithms in python and discuss the trade-offs between traditional approaches and the EC key exchanges.

Math Anxiety: Causes, Effects, and Solutions

Anna Kwartin, Shenandoah University

3:25-3:45, H204

(student talk)

Math anxiety is a persistent issue among college students that can negatively impact performance, confidence, and motivation in math courses. The goal of this research study is to examine which academic support methods Shenandoah University college students use to help themselves with math anxiety and which methods students perceive as most effective in helping them succeed. Research was conducted using two surveys, one at the beginning and one at the end of a semester, with questions related to math anxiety, the three outlined support methods, and students' perceived effectiveness of those methods. The key findings of this research study are that low levels of confidence in math lead to more math anxiety, students feel their low math confidence stems from a lack of foundational skills, it doesn't matter how effective students think a support method is if they still choose not to use it, if you have liked your past math teachers you're more likely to be confident and less anxious in your current math class, and anxiety and confidence play a role in students deciding whether or not to make steps to help themselves in math. These findings helped inform the development of two proposed intervention programs for students to be more confident and less anxious when going into their math classes. The first proposed intervention is a structured review program at the beginning of every semester, which is focused on building and reviewing basic math skills so students feel prepared for their class. The second intervention program requires or gives an incentive to students to get tutoring so they are more proactive in their learning and less reactionary.

Living Computers: Can Brain Organoids Power AI Architectures?

Dustin Delgross, Shenandoah University

3:25-3:45, H205

(student talk)

Modern AI development has two primary bottlenecks: hardware limitations and the architectures running on top of them. As transistor scaling slows, traditional silicon-based and von Neumann architectures struggle to meet growing computational and energy demands of large machine learning workloads. The widespread adoption of AI in business and consumer applications means that routine AI training and testing workflows have become a common business requirement. Data center energy consumption has risen as natural language processor and large language model implementation continues to grow. Resource consumption is projected to increase, with data center projects to be

constructed nationwide within the next 10 years, specifically dedicated to AI training and research. To mitigate the computational and environmental impact of this growth, researchers have begun exploring biologically inspired alternatives that utilize properties of neural systems. Two methods have emerged from these experiments: synthetic biological semiconductors, and brain organoids derived from stem cells. Both methods utilize characteristics of neural networks, like parallel processing and nonlinear dynamics. Researchers have begun examining neural structures as dynamical systems using living neurons cultured from stem cells into small brain-like organoids. Organoids may provide parallel, dynamic, energy-efficient compute power suitable for machine learning applications. Early studies show that integrated neurons may be able to more efficiently support machine learning workloads using a fraction of the energy requirements of a traditional CPU/GPU architecture. This review synthesizes current research in neuromorphic and biological computing to evaluate their potential as a sustainable next generation in AI architecture.

Origami Constructions: In Three-dimensional Space
Noah Hanscom, St. Mary's College of Maryland
3:25-3:45, H206
(student talk)

Mathematical origami is a theoretical extension of paper origami where the complex plane can represent an infinitely large piece of paper, and the "folds" of this paper are represented by a set of allowed angles. We study the structure of the set of intersection points between all pairs of angles. This has been well described in 2 dimensions; however, little is known about them in multidimensional space. We determine how an origami set that generates a lattice in three-dimensional space is altered by introducing an additional allowed angle. We also implement an algorithm in SageMath that computes the intersections of pairs of allowed angles from given starting points. The algorithm then computes the projections from the new intersection points back onto the real number line.

Invited Address

AI Is Changing Our Profession: What Do We Do?
Alexander Diaz-Lopez , Villanova University
4:00-5:00, H115L

Generative AI is already changing mathematics education and, more broadly, our profession. Whether we welcome it, resist it, or remain unsure, these tools are influencing teaching, assessment, student learning, and even mathematical research. This talk will explore how AI is reshaping the landscape of our field and profession, highlight emerging developments, and invite us to think carefully about how we should respond.