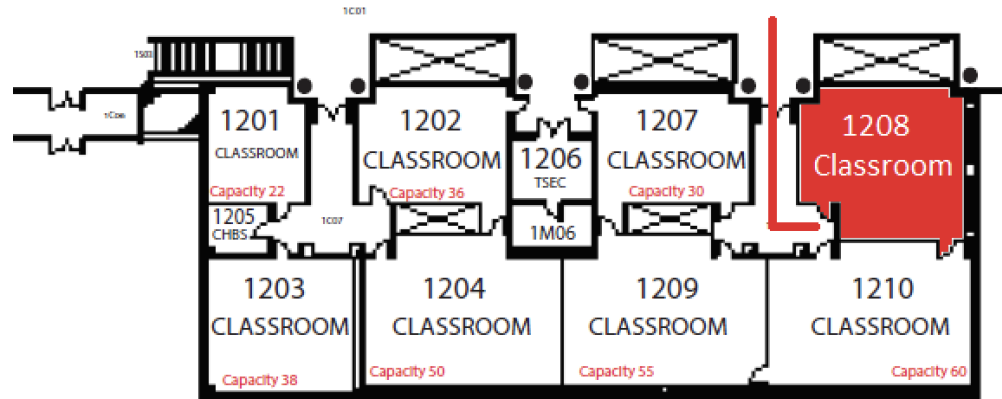


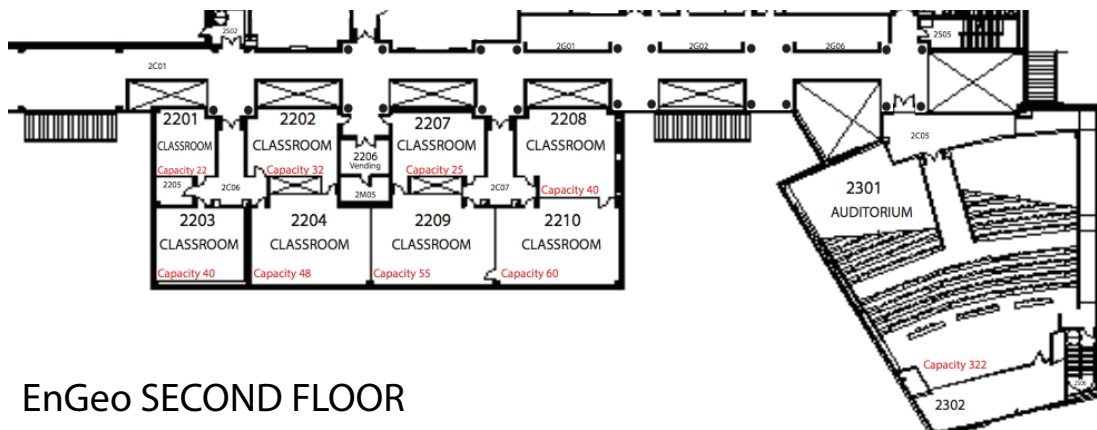
## SUMS 2025 TENTATIVE TIMETABLE

When	What & Where				
9:00-10:00	Registration & Breakfast EnGeo Building, 2nd floor hallway				
10:00 - 10:10	Welcome Dr. Sam Prins (JMU, CSM Dean) 2301				
10:10 - 11:00	Opening Talk Dr. Kimberly Sellers (NCSU) 2301				
11:15 - 11:30	Talk Session I				
	C. Phillips 2209	D. Laddha 2210		R. Nomikos 1209	L. Pelham 1210
11:35 - 11:50	Talk Session II				
	K. Gill 2209	M. Ryan 2210	M. Grove 1208	J. Layne 1209	Z. Harrington 1210
11:55 - 12:10	Talk Session III				
	C. Don Juan 2209	T. Gafurov 2210	D. Heath 1208	M. Cooper 1209	L. Paredes Idiaquez 1210
12:15 - 12:30	Panel Session I				
			Career/Industry 1208	Graduate School 1209	REU 1210
12:30-1:45	Lunch and Poster Session Hallway				
1:50 - 2:05	Panel Session II				
			Career/Industry 1208	Graduate School 1209	REU 1210
2:10-2:25	Talk Session IV				
	A. Callahan 2209	B. Droubay 2210	T. Murrell 1208	M. Marfo 1209	A. Yu 1210
2:30-2:45	Talk Session V				
	S. Weimar 2209	T. Porter 2210		T. Tarter 1209	J. Ungerleider 1210
2:45-3:00	Afternoon Coffee & Tea Hallway				
3:10 - 4:00	Closing Talk Dr. Neal Bushaw (VCU) 2301				
4:10-4:20	Prize session 2301				
4:20	Conference Closing 2301				

All events are on the first and second floors of the JMU EnGeo building.



**EnGeo First Floor**



EnGeo SECOND FLOOR

Wireless Network: Log onto “JMU-Visitors”  
Username: sums@jmu.edu  
Password: 878085  
The username and password are case specific.

*9:00 - 10:00 Registration and Breakfast*

2nd floor hallway

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If you registered online, you should pick up your name tag at the registration table. If you still need to register, please do so at the same table.

Poster presenters should take their posters to room EnGeo 2202 for check in.

Be sure to come to the Prize Session at the end of the day!

*10:00 - 10:10 Opening Remarks*

auditorium 2301

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Join Dr. Samantha Prins, Dean of the College of Science and Mathematics, as we welcome you to SUMS 2025.

*10:10 - 11:00 Opening Address*

auditorium 2301



## **Dispersed Methods for Handling Dispersed Count Data**

*Dr. Kimberly Sellers*

*North Carolina State University*

While the Poisson distribution is a classical statistical model for count data, it hinges on the constraining equi-dispersion property (i.e. that the mean and variance equal). This assumption, however, does not usually hold for real count data; over-dispersion (i.e. when the variance is greater than the mean) is a more common phenomenon for count data, however data under-dispersion has also been prevalent in various settings. It would be more convenient to work with a distribution that can effectively model data (over- or under-) dispersion because it can offer more flexibility (and, thus, more appropriate inference) in the statistical methodology. This talk introduces the Conway-Maxwell-Poisson distribution along with several associated statistical methods motivated by this model to better analyze count data under various scenarios (e.g. distributional theory, generalized linear modeling, control chart theory, and count processes). As time permits, this talk will likewise acquaint the audience with available associated tools for statistical computing. Interested persons can learn more about this distribution via the reference, *The Conway-Maxwell-Poisson Distribution* (Cambridge University Press, 2023).

2209 **On the Existence of Locally Linear Strongly Regular Graphs**

*Connor Phillips, James Madison University*

If graph  $\Gamma$  is an  $srg(n, k, 1, \mu)$ , it has the property that each edge lies in a unique triangle, and so we construct a new graph with vertices as the triangles of  $\Gamma$ . We derive the spectrum of this new graph, and use its spectral properties to find strong necessary conditions on the existence of the original graph  $\Gamma$ .

2210 **Modeling of AI's Data Center, Emission, and Workforce Impact**

*Divya Laddha, Freedom High School*

We model generative AI's impacts on data centers, emissions, resources, and workforce via coupled ODEs and a labor compartment model (At Risk, Unemployed, Reskilled). Numerical simulations test adoption rate ( $r$ ) and policy pushback, tracking energy, emissions, water, and jobs.

1209 **Parallel Postulate Without SAS: Equivalentents and Independence**

*Romeo Nomikos, James Madison University*

In classical Hilbertian geometry, Euclid's parallel postulate has many equivalentents. It has been shown previously that the equivalence between the parallel postulate and Playfair's axiom no longer holds in the absense of SAS triangle congruence. We investigate which other equivalentences will fail in a non-SAS geometry.

1210 **Rocket Launch Acoustic Flame Trench Analysis**

*Lydia Pelham, Adam Short, James Madison University*

The aim of this project is to gain a greater understanding of flame trenches and how they affect rocket launches. This research investigates how modifications of the flame trench's physical configuration can mitigate the noise directed at the rocket to reduce structural damage to the rocket and its payload.

2209 **Approaches to the L’vov-Kaplansky Conjecture**

*Kylie Gill, Longwood University*

The L’vov-Kaplansky Conjecture is an open question in the field of Algebra, which asks if the image of a multilinear polynomial acting on the space of  $n \times n$  matrices is a subspace. We consider new approaches to the conjecture, including using an analytic version: the Density Dimension-Free L’vov-Kaplansky Conjecture.

2210 **Geometry of Solutions to PDE’s via Laplace Invariants**

*Matthew Ryan, Virginia Tech*

Equivalence of projective surface immersions with linear PDE systems is of perennial interest in geometry and integrable systems. We study the latter using the sequence of Laplace invariants of a planar linear scalar hyperbolic PDE in a novel way and discuss applications in Appell’s hypergeometric functions.

1208 **TetraStix + HexaStix = TetraHexaStix**

*Marija Grove, Bethany Droubay, Maxwell Cooper, JMU*

Inspired by George Hart’s “72 Pencils” and based on Matt Parker’s pencil sculpture videos, we have constructed a TetraHexaStix and its accompanying TetraStix and Hexastix. The TetraHexaStix is the union of the TetraStix and HexaStix, visual representations of the orthogonal and tetrahedral axes, respectively.

1209 **An Upper Bound on Higher Moments of Newform Dedekind Sums**

*John Layne, University of Virginia*

The classical Dedekind sum arises in the automorphy factor of the Dedekind eta function, and its value distribution has been studied extensively. We study the value distribution of a variant of the Dedekind sum associated with two primitive Dirichlet characters, known as a newform Dedekind sum.

1210 **Record Linkage Techniques: A Comparative Study**

*Zach Harrington, James Madison University*

An introduction and discussion of record linkage and various linkage methods are presented. Specifically, the Fellegi-Sunter Method, Expectation-Maximization Method, and the EpiLink Algorithm will be discussed. Afterwards, we dive into an application of these methods on simulated health datasets(Parrish, 2024).

2209 **Equivalence of incidence matrices and its applications**

*Cole Don Juan, University of Montevallo*

We study equivalence of various incidence matrices of graphs and signed graphs. This produces a condition for a graph to be bipartite. Also, we look into the equivalence of a net incidence matrix of a signed graph and the incidence matrix of the underlying undirected graph. This aids in finding the Moore-Penrose.

2210 **Using ODEs and Control Theory to Optimize Mentorship Costs**

*Timofey Gafurov, Lake Braddock High School*

The compartments of a Susceptible-Exposed-Infected-Recovered model are modified to describe the positive propagation of knowledge. Optimizing the percentage of mentors for a student body attempts to maximize the informed population. Results of linear and non-linear control are then compared to a constant control model.

1208 **Time-Scale Model for Glucose Tolerance Tests**

*Dane Heath, West Virginia Wesleyan College*

Glucose tolerance tests are defined, time scales are introduced, and a time-scale model is developed for a pre-existing differential equation to model glucose levels in the bloodstream.

1209 **Trimming Tests for Divisibility**

*Maxwell Cooper, James Madison University*

Divisibility tests have been used since the year 500. In this talk, we take a deep dive into a special type of divisibility tests called trimming tests. We will build and use different types of trimming tests and show the connections between them. We also look at divisibility in other bases and preserving remainders.

1210 **Mapping Boundaries of Coanda Jets**

*Leon Paredes Idiaquez, Gregory Granahan, James Madison University*

Rocket launches generate extreme acoustic waves that travel along flame trenches and threaten sensitive payloads. This talk models Shock Associated Noise from Coanda wall jets using a Coanda flare framework, with improved Schlieren imaging to refine jet boundaries and predict and reduce acoustic loads.

## 12:15 - 12:30 Panel Session I

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### 1208 **Career Panel**

*Will Clewett, Software Engineer*

*Grant Wagner, Naval Surface Warfare Center-Dahlgren Division*

Ask questions and learn about careers involving mathematics and statistics.

### 1209 **Graduate Panel**

*Rao Chaganty, Old Dominion University*

*Christine Demars, James Madison University*

*Andre Mas, NC State University*

Learn about what life is like as a graduate student in mathematics or statistics.

### 1210 **REU Panel**

*Alex Capaldi, James Madison University*

*Cole Don Juan, University of Montevallo*

*John Layne, University of Virginia*

*Taylor Murrell, Virginia Tech*

Learn all about the process of applying for, and participating in, an REU program.

## 12:30 - 1:45 Lunch

hallway

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**LUNCH:** If you are hungry and have a circle on your badge, please pick up a boxed lunch near the registration table at 12:30. (If you do not have a circle, it means that you registered after our catering order deadline. But you still might get a free lunch. Please wait until 12:45 to check for unclaimed lunches).

## 12:30 - 1:45 Poster Session

hallway

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**POSTER SESSION:** Students will be near their posters during lunch. Please stop by to see their excellent work! Poster judging will start by 12:45.

### **Overcoming Noise in Spatial Data Using Algebraic Topology**

*Alethea Callahan, The College of William & Mary*

### **Partial Covering of the Sphere with $N = 5$ Caps**

*Ryan Childress, Longwood University*

### **Seed Dispersal Strategies: Evaluating Spatial Patterns**

*Anaiel Jibrelle Dayrit, The College of William & Mary*

**Using Compartmental Systems of Ordinary Differential Equations**

*Timofey Gafurov, Lake Braddock High School*

**Partial Sphere Covering**

*Emma Heisig, Longwood University*

**Coupling Phase Field and Reaction Diffusion Equations for Phase Separation Dynamics of Membrane-less Organelles**

*Yulee Kang, William and Mary*

**Modeling AI's Data Center, Emissions, and Workforce Impact**

*Divya Laddha, Freedom High School*

**Ergodic Proof of Szemerdi's Theorem & Green-Tao Theorem**

*John Layne, University of Virginia*

**Modeling Synaptic Dysfunction as Neural Contagion**

*Michelle Marfo, Osbourn Park High School*

**Reconstructing Chaotic Dynamics with Delay Embedding and GPR**

*Joey Park, Thomas Jefferson High School for Science and Technology*

**Convex Geometry and Frame Theory**

*Kevin Rivera-Ayala, Longwood University*

*1:50 - 2:05 Panel Session II*

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1208 **Career Panel**

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*Grant Wagner, Naval Surface Warfare Center-Dahlgren Division*

Ask questions and learn about careers involving mathematics and statistics.

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*Cole Don Juan, University of Montevallo*

*John Layne, University of Virginia*

*Taylor Murrell, Virginia Tech*

Learn all about the process of applying for, and participating in, an REU program.

2209 **Overcoming Noise in Spatial Data Using Algebraic Topology**

*Alethea Callahan, William & Mary*

This project utilizes morphological image processing and persistent homology to extract population patterns from noisy population data. We compare clean, noisy, and smoothed images. Results show that smoothing removes fine detail but preserves key topological features, supporting this method for pattern analysis.

2210 **Modeling probiotic control of white-nose syndrome in bats**

*Bethany Droubay, James Madison University*

Caused by an invasive fungus, white-nose syndrome (WNS) has spread across North America and devastated many bat species. We built a differential and difference equation model of a probiotic control to combat WNS. We find that the control is potentially effective in mitigating WNS and restoring bat populations.

1208 **Cryptographic Steganography: Methods for Undetectable Encrypted Communication**

*Taylor Murrell, Virginia Tech*

Steganography conceals existence; cryptography conceals content. We study LLM-based cryptographic steganography, embedding ciphertext in fluent LM output so a passive observer must first detect covert communication.

1209 **Graph-Based SEDR Model of Neural Signal Dysfunction**

*Michelle Marfo, Osbourn Park High School*

This study models synaptopathies, disorders from failed synaptic transmission, with a graph-based SEDR framework. Neurons move through Susceptible, Exposed, Dysfunctional, and Recovered states; ODEs with  $\beta$ ,  $\sigma$ , and  $\gamma$  drive spread. Simulations across network topologies reveal how connectivity and weights drive propagation.

1210 **Viscous film in tube: PDE simulation and probability**

*Aya Yu, Virginia Commonwealth University*

With viscous films moving in a thin tube, waves form and could form plugs. This is significant in patients with bronchitis, where their airway could be blocked. There has been less work on the transient conditions where plugs could form probabilistically. We look at that transient region through PDE simulations.

2209 **Exploring the Mandelbrot Set in Abstract Algebras**  
*Shane Weimar, Liberty University*

The Mandelbrot set is a well-known topic in complex analysis. Less discussed is the Mandelbrot set in hypercomplex algebras. This talk will discuss the characterization and attributes of the Mandelbrot set in an abstract two dimensional real algebra.

2210 **Self-Sorting in a Continuous Opinion Dynamics Model**  
*Timothy Porter, Virginia Commonwealth University*

A continuous model of opinion dynamics based on one by Baron (2021), is developed. The model by Baron is first recreated, and then extended to introduce a representation of self-sorting. The changes this extension makes to the transitions between different macroscopic states and the behavior of the model as a whole is then studied.

1209 **A Faster Attack on LFSR Recurrences**

*Timothy Tarter, Garret Pribracha, Arsenii Herasymov, James Madison University*

LFSR sequences are used to generate pseudo random numbers and encode binary plaintext. Cryptographers utilize minimal recurrences to reverse engineer the original sequence. Our algorithm offers an alternative to the current industry standard for finding the minimal recurrence of a complete binary string.

1210 **Predicting Acoustic Loads on Rockets at Launch**  
*Joseph Ungerleider, James Madison University*

Predicting acoustic loading on rockets is vital in minimizing damage during liftoff. The NASA SP-8072 is an outdated prediction model developed in 1971. Despite being over 50 years old, it is still the best model available today. This paper will discuss and compare possible improvements upon the NASA SP-8072 model.

*2:45 - 3:00 Afternoon Coffee and Tea*

2nd floor hallway

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Please join us for tea and coffee in the EnGeo foyer. This is your last chance to enter the candy contest!

*3:10 - 4:00 Closing Address*

auditorium 2301



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## **I heard there was a secret chord . . .**

*Dr. Neal Bushaw*

*Virginia Commonwealth University*

What is a musical chord, to a discrete mathematician? What about a scale, or a rhythm? In this talk, we explore these (and other) mathematical versions of musical notions, with a focus on problems that seem like combinatorics. How many scales or chords are there with some specified property? How can we measure a scale, chord, or rhythm? Can we enumerate all chords (and thus find Cohen's Secret Chord along the way)? Can we use any of this to make drum machines? We'll see surprising connections between these musical notions, and glimpse the tip of a mathematical iceberg which began with the study of wealth inequality by Muirhead and Lorenz in the early twentieth century, and which was later expanded by mathematical titans Schur, Littlewood, Hardy, and Polyá. This talk is intended for a general audience – no background in either music theory or combinatorics is expected! This talk includes joint work with Viktoriya Bardenova, Brent Cody, Paul Fay, Luke Freeman, Chris Leffler, Maya Tennant, and Toby Whitaker.

*4:10 - 4:20 Prize Session*

auditorium 2301

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Please join us for the prize session in the auditorium. Poster competition winners and the candy contest winner will be announced!

*4:20 Conference Closing*

auditorium 2301

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## Jellybean Competition

**Rules:** Each person may enter only once. Your guess must consist of a connected *interval* of real numbers. The winning entry will be the smallest interval containing the actual number of jellybeans, with any ties broken using the distance from the center of your interval to the actual number. The winner will be announced at the prize session at the end of the day.



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Thank you to all of the volunteers who make this conference possible. We are grateful for support from JMU's College of Science and Mathematics, and the General Education Program.

*Join us next year for SUMS 2026!*

[www.jmu.edu/mathstat/sums](http://www.jmu.edu/mathstat/sums)