

UNDERGRADUATE MATH SEMINAR Steinmetz Symposium!

In deference to the Steinmetz Symposium being held on **Friday, May 8**, there will not be a separate math seminar this week. Instead, we encourage you to attend some math talks in Bailey 207.

Session IV**Mathematics****Bailey 207**

3:40 pm, Sarah Lehan-Allen, Commuting Matrices: One of the first fundamental facts students learn in linear algebra is that matrix multiplication is generally not commutative: for square matrices A and B , we do not usually have $AB=BA$. This naturally leads to the question: under what conditions do matrices commute? While the identity matrix and the zero matrix commute with every matrix, there are many other matrices that share this property under certain structural constraints. In this talk, we investigate when two matrices commute and how these conditions relate to the structure of the matrices themselves. Using Jordan Normal Form and Jordan Decomposition, we characterize classes of matrices whose entries and algebraic structure guarantee that $AB=BA$.

4:00 pm, Henry Howe, Factorization in Domains: Applications in Error Correction: Factorization is a central computational tool in mathematics and its applications, most commonly utilized with integers and polynomials. In practice, the reliability of factorization underpins many modern technologies, with one such example being Reed-Solomon error correction. Reed-Solomon uses the factorization of polynomials to encode and recover data transmitted over noisy channels. Reed-Solomon and many algorithms like it can be understood as detecting errors by measuring how badly division fails of something that should have been a factor before the introduction of some error. This thesis examines how divisibility shapes the structure of various classifications of integral domains, focusing on the transition from Unique Factorization Domains to Euclidean domains. In Unique Factorization Domains, elements uniquely break down into prime factors, ensuring that divisibility and greatest common divisors remain well defined up to associates. Building upon this, the study explores Euclidean domains, which equip these domains with formal division algorithms. In these domains, when exact division between two elements fails, a division algorithm can be applied so that the resulting remainder is strictly bounded. In a sense, this is already enough to determine how badly division fails. However, this only identifies errors and is not sufficient for correcting them. For this reason, we build the Euclidean algorithm off of our choice of division algorithm, which enables us to pose and formally prove a generalized rational reconstruction theorem. By applying this generalized theorem directly to polynomial rings, this thesis describes how the encoding and decoding processes of the Reed-Solomon algorithm depend on the factorization properties of the underlying domains. This ultimately demonstrates how the theoretical study of abstract domains directly connects to the applied setting of modern coding theory.

4:20 pm, Ryder Mollo, Paradoxes in Probability: If there are 23 people in a room, what is the probability that at least two of them will share the same birthday? This well-known question in probability theory is an example of a veridical paradox. This talk will discuss three classic paradoxes in probability theory: The Birthday Problem, the Monty Hall Problem, and the St Petersburg Paradox. We will examine proposed solutions and provable results for each problem. Additionally, variations of each problem will be analyzed, and simulations will be used to illustrate and confirm results.

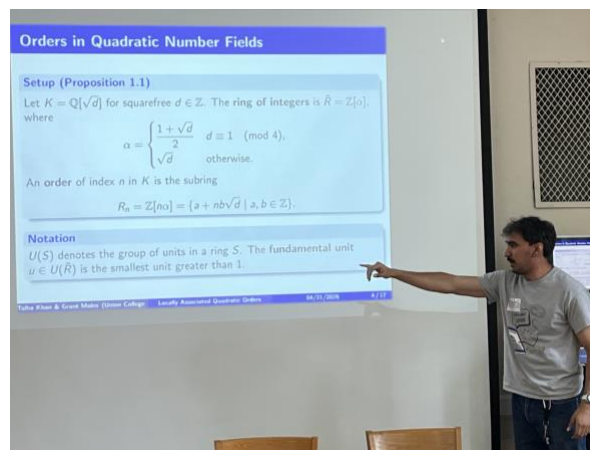
4:40 pm, Samantha Picciotti, Mathematical Epidemiology and the SIR System: how we can reduce the spread of infectious diseases: During Fall Term in the 2025-26 academic year, I combined epidemiology, virology, and mathematics to model past and predict future influenza seasons in New York State. Every year, roughly in October through May, we experience the flu season, and I wanted

to bring awareness to the prediction and planning that goes into having accurate influenza data available to the public. With data from the NYS Department of Health and MATLAB, I used the SIR system (Susceptible, Infected, Removed) of ordinary differential equations to model the 2018-19, 2020-21, and 2022-23 New York State flu seasons. I used these models to write a modified code that predicted the 2025-26 flu season. This model helps simulate how a contagious disease spreads and eventually declines in a population over time. In addition to building these flu models, I looked at the different methods of how flu season data is collected, as well as some ethical concerns that come with the data collections. Finally, I looked at some of the limitations that come with mathematical modeling, and what improvements I could make to the models and data collection. Modeling flu seasons is an important part of public health preparedness as it helps with vaccine timing, outbreak response, and hospital readiness.

5:00 pm, Brooke Rosenshine, Optimal Control Theory Applied to Topics in Engineering: This presentation will explore optimal control problems and different methods of developing and solving them. An optimal control problem is a mathematical problem that involves selecting a control equation to find a maximum or minimum potential outcome with respect to time based on limiting constraints. There will be a focus on applying these problems to a variety of engineering scenarios. After providing background on optimal control problems and how they can be utilized, there will be an emphasis on examining realistic engineering problems and developing optimal control problems to maximize desired outcomes. These problems will then be analyzed using modeling software to simulate the solutions. This will allow for a deeper and more concrete understanding of the implications of mathematics and eventually assist in presenting the findings of this research.

Union Represented at HRUMC

On Saturday, April 25, eight Union students, **Tim Belin, Diego Fuentes-Alvarado, Ryan Fusco, Talha Khan, Muhammad Owais, Garnet Ramsey, Brooke Rosenshine, and Audrey Wankel**, and three Union math professors, **Sean Carney, Paul Friedman, and Grant Moles**, traveled to Vassar College and attended the 32nd Hudson River Undergraduate Mathematics Conference. Three of these Union students gave talks: Talha, "*Locally Associated Orders in Real Quadratic Number Fields*"; Muhammad, "*Improving Full Waveform Inversion Through Data Normalization for the Wasserstein Metric*"; Brooke, "*Optimal Control Theory Applied to Topics in Engineering*" (which you will be able to hear at Steinmetz!). In addition to these three talks, there were *over 100 others* in more than 30 sessions, in topics across Algebra, Analysis, Applied Mathematics, Geometry, Geometry, History of Mathematics, Number Theory, Probability, Statistics, and Topology. **Professor Joes Perea** from Northeastern University delivered a wonderful keynote address, "*Topological Time Series Analysis*".



Talha Khan '26 presenting at HRUMC

Does this sound interesting? If so, look forward to next year's HRUMC at Skidmore College!

ReUnion Weekend, Friday, May 15, 4:00 – 5:00pm
Math Department Reception: Bailey 204 (Math Common Room)
 Enjoy a casual reception and light refreshments with alumni who majored in math.