ISMAA 2026 Abstracts
University of Illinois Springfield
March 27 & 28, 2026

Pre-conference Workshop

Lauren Keough, Grand Valley State University, *Math Circle Magic for All*
One of my favorite ways to interact with people is through doing problems that people don't always think of as "math". I've led math circles at GVSU for several years and will present some of my favorite problems. Some of these are magic tricks, and some are just magical in the cool math one discovers while exploring them. This will be an interactive talk where audience members get to discuss math-ish problems with each other and will (hopefully) get to leave with a new discovery of their own.

Plenary Talks

Paul Sirvatka, College of DuPage, *Should You Teach Calculus Concepts to Students with Minimal Math Skills? That's a Question!*
On the first day of Introductory classes, I introduce the concept of a derivative in order to disarm students apprehension toward science, set the groundwork for understanding that math is a language used by scientists to make scientific understanding easier, and to captivate the students into my own teaching style. The lesson is fun and novel and shared by all my students for over 30 years. We will also discuss how advanced concepts of calculus find exceptional meaning in the field of meteorology.

Lauren Keough, Grand Valley State University, *My Two Word Teaching Philosophy*
Teaching can be incredibly hard, and it's easy to lose sight of the big picture. In this talk I will discuss what happened when I embraced a two word teaching philosophy: empathy first. This attitude has changed what I do in my classroom - assessment techniques, activities, and what I value. In a time when I both feel a need for radical change and am just so tired, I'll try to offer some concrete things I've tried, both big and small from efficient and effective ways to implement different assessment techniques to conversations with struggling students. This talk is a tribute to everyone I've ever had the privilege of talking about teaching with, including my students: I've learned something from all of you!

Hei-Chi Chan, University of Illinois Springfield, *AI, vectors, and a billion-dollar industry*
The rise of generative AI has sparked a fundamental shift in how information is stored, searched, and retrieved. At the core of this transformation are key components: (1) vector representations-familiar mathematical structures that encode "meaning" in high-dimensional spaces, and (2) the systems built to manage them, namely vector databases. These databases are designed to enable Approximate Nearest Neighbor (ANN) search, a technique that makes it possible to find semantically similar items quickly and efficiently. They power applications such as intelligent search, recommendation engines, and conversational AI. In this talk, we will discuss the

mathematical concepts and models connected to these developments. We will also explore how the demand for these technologies has fueled explosive industry growth, creating a billion-dollar market within the last several years. This talk emphasizes intuition, real-world relevance, and the opportunities emerging at the intersection of mathematics and AI.

Paul Blanchard, Boston University, *Newton's Method: Complex Numerics and Complex Dynamics*
Newton's method is an iterative root-finding algorithm that is both simple and surprisingly efficient. We start with an initial guess for the root and apply the algorithm repeatedly until we obtain the desired approximation. Unfortunately, a random guess does not always lead to a root. In this talk, we use the theory of complex dynamics along with some computer graphics to explain the difficulties that might arise, and we suggest ways to avoid these pitfalls. As the story unfolds, we encounter both chaos and fractals.

Contributed Talks—Friday

Maggie Alibaikzadeh and Aimee Sutton, Illinois State Board of Education, *ISBE Statewide Update: The Illinois Comprehensive Numeracy Plan*
The Illinois State Board of Education is currently developing the Illinois Comprehensive Numeracy Plan, a statewide initiative aimed at strengthening mathematics teaching and learning. Draft 2 of the plan was released on February 19, 2026, and is now available for public comment through the end of March. During this session, the numeracy team will provide an overview of the updated draft, including the plan's vision, key goals, and major areas of focus. The session will also highlight significant revisions from the first draft and outline ways educational partners can engage in the feedback process.

Enrique Treviño, Lake Forest College, *An almost-always measure of the failure of unique factorization*
In a second abstract algebra course it is common to introduce the concept of unique factorization domains and how they can be classified in terms of their class group. A classic theorem is that when the class group is trivial, the domain has unique factorization, but less commonly mentioned is how the class group encodes other nice properties about factoring in a particular domain. In this talk we will explore the concept of elasticity, which is one way to measure the failure of unique factorization. Historically, the elasticity is defined in terms of a "worst-case" scenario. In this talk we will also explore the elasticity of typical elements instead of just the extreme ones.

Sepher Akbari*, Lake Forest College, *Polynomials as Logic Gates: Solving Constraint Satisfaction Problems with Gröbner Bases*
Combinatorial design challenges, including graph coloring, scheduling, and constraint satisfaction problems, are typically addressed through discrete search algorithms such as backtracking. This paper discusses an alternative framework rooted in commutative algebra, in which the search space is modeled as an affine variety associated with a zero-dimensional

polynomial ideal. We describe the encoding of logical constraints such as mutual exclusion and relational dependencies into polynomial generators, which enables the application of Gröbner bases to the system. Using a constrained assignment problem as a case study, we demonstrate how elimination theory can be used to decompose the solution space and how Hilbert's Nullstellensatz provides a certificate of non-existence for inconsistent systems. This approach treats Gröbner bases as a deterministic framework for the structural analysis of discrete problems.

Brooke Randazzo, Augustana College, with Rachel Rupnow, *Student Partial Meanings for Quotient Groups*
Quotient groups are a central concept in undergraduate abstract algebra; they are especially important to students' understanding of structure and key theorems such as the First Isomorphism Theorem. Students may hold several pieces of information about these quotient groups, some of which may be more productive than others regarding generation of quotient groups and proving statements about quotient groups. This study involved interviews with six students from two different institutions, where they described their understanding of quotient groups, generated Cayley tables for quotient groups, and constructed proofs involving quotient groups. Thematic analysis was used on the transcripts to look for "partial meanings" for quotient groups that students used in their thinking. We present a subset of these meanings that seemed to differentiate success on these tasks. First, most students were able to consider both cosets as sets and cosets as elements, although some moved more fluidly between the two. Second, all students used the coset algorithm to generate cosets, with efficiency determined by whether or not they recognized that these sets must be distinct. Third, students understood quotient groups in terms of partitioning the original group, especially using this to get information about the size of the quotient group. Finally, while all students recognized that a quotient group is a group and some used this idea to generate Cayley tables more efficiently, most did not leverage consequences of this idea in particular proofs. Implications for supporting productive uses of these partial meanings while teaching will be discussed.

Soad Abdullah(+), Northern Illinois University, *Symbolic Logistic Regression for Interval-Valued Predictors: A Simulation Study and Application to Health Data*
Logistic regression is widely used for modeling binary outcomes, but it typically assumes that predictors are observed as exact numerical values. In many practical situations, however, predictors may only be available in grouped or interval form due to aggregation, privacy constraints, or reporting uncertainty. This study investigates symbolic logistic regression as an approach for modeling binary outcomes when predictors are represented by intervals. The performance of symbolic logistic regression is compared with classical logistic regression through two simulation studies that examine different sources of predictor uncertainty. The first study considers asymmetric interval uncertainty around the underlying predictor and compares symbolic models with classical logistic regression fitted using the exact predictor. The second study examines a measurement error scenario in which the classical model is fitted using a noisy predictor. In both settings, symbolic logistic regression models based on midpoint and midpoint–

width representations are evaluated. The methodology is further illustrated using NHANES health data, where age is represented by grouped intervals. The results indicate that symbolic logistic regression can provide stable and interpretable inference when predictors are reported as intervals or coarsened values.

Devin Gloeckner*, Millikin University, *Isomorphisms onto a Limited Lattice Structure for Graph Embedding*
In this talk I will explain embedding and give an introduction to non-planar embedding. I will also be describing the limited lattice structure and what the rules on traversing it are. I will then present on the current progress of what markers can tell if a graph can be broken into multiple layers. I'll also talk on some non-planar graphs that can be embedded on this structure. Finally, I'll be talking on real world applications of the system.

Luke Pekol*, Lewis University, *Quantifying the Court: A Statistical Analysis of Performance Metrics in NCAA National Collegiate Men's Volleyball*
This study investigates the presence and extent of home-court advantage in NCAA National Collegiate Men's Volleyball through a comprehensive statistical analysis of 18 game-related performance metrics. Using data from the 2024 and 2025 seasons, we compare team performance in home and away game statistics to identify statistically significant differences that may be indicative of a competitive advantage when playing on home courts. Statistical methods were applied to evaluate performance variations in areas such as serving, point-scoring, kills, blocks, digs, and points. The results demonstrate statistically significant advantages for home teams in several key metrics, suggesting that factors such as environmental familiarity, crowd support, and travel distances may enhance performance. These findings provide a deeper understanding of competitive dynamics in NCAA National Collegiate Men's Volleyball and offer valuable insights that can be used to influence traditional ranking methodologies.

Jeremy F. Alm, Southern Illinois University, with Laura Corey, *Aiming at the Wrong Target: rethinking the teaching of logarithms in precalculus*
The standard textbook presentation of logarithms tends to focus on solving equations involving logarithms, using logarithms to solve equations involving exponential functions, and on graphs of logarithmic functions and their transformations. However, these skills do not align well with actual scientific use cases. We argue that STEM students, including math majors, would benefit from a more diversified approach to teaching logarithms.

Melanie Pivarski, Roosevelt University, *Recruiting and Preparing Future Math (and Science) Teachers Through our NOYCE Program*
Roosevelt University is finishing up our NSF-NOYCE grant, which aims to increase the number of highly qualified math and science high school teachers. Through these past years, we've had both challenges and successes. In this talk, I will describe some of our outcomes and advice for those seeking to prepare future math teachers from the perspective of a math faculty member.

Eli Atkins(+), Southern Illinois University Carbondale, *A Structural Correspondence Between Strongly Regular Graphs and Relation Algebras*
Graph theory can be used to describe complex algebraic structures with simple combinatorial objects. In particular, highly symmetric graphs can be used to relate graph colorings and algebraic systems. In this talk, I explore how the structural properties of graph colorings can be used to characterize algebraic representations of finite relation algebras.

I establish a correspondence between strongly regular graphs and algebraic representations of finite symmetric integral relation algebras on three atoms using 2--colorings of K_n. I show that a 2--coloring of K_n yields an algebraic representation of a relation algebra on three atoms precisely when its color-induced subgraphs are strongly regular graphs whose automorphism groups act with rank~3 on pairs of vertices. Thus, algebraic representations correspond exactly to complement pairs of rank--3 strongly regular graphs. Conversely, this result organizes strongly regular graphs into finitely many types determined by the local edge structure on triples of vertices.

Zach Pekol*, Lewis University, *Quantifying the Court: Predictive Modeling for NCAA National Collegiate Men's Volleyball Rankings*
This project explores predictive analytics in NCAA National Collegiate Men's Volleyball using the Colley ranking method and a focus on incorporating home-court performance into the model design. Building on prior statistical analysis of home court advantage, we extend the Colley model by applying custom weightings to game outcomes based on location. Using the optimal combination of home, away, and neutral weights that minimize error, we compare predicted rankings to actual AVCA Coaches Polls. The model trained on 2024 data was then tested on 2025 season results to evaluate its consistency. By assigning weights based on game location, the model achieved high prediction accuracy, reinforcing the importance of accounting for venue effects in modeling. Additionally, the model's performance across seasons demonstrates its potential for predicting team strength beyond a single year. This work highlights how statistical analysis and a modified Colley algorithm can be combined to generate assessments of competitive performance in NCAA National Collegiate Men's Volleyball.

Brenia Smith*, Southern Illinois University Carbondale, *Sophie Germain: A Mathematician's Final Years*
Sophie Germain was a self-taught French mathematician who, despite the adversity she faced as a woman, made significant contributions to number theory and Fermat's Last Theorem. Growing up during the French Revolution, she studied mathematics independently in her family's library despite her parents' wishes. She corresponded with mathematicians such as Lagrange and Gauss using the pseudonym M. Leblanc to conceal her identity and the fact that she was a woman. For much of her life, she worked on Fermat's Last Theorem and elastic surfaces, and a class of prime numbers known as Sophie Germain primes is named after her. Later in life, she was diagnosed

with breast cancer, which eventually led to her death. Letters between Germain and her friend Guglielmo Libri provide insight into her personality and her thoughts during her final years. This talk will explore Germain's correspondence with Gauss and Libri and the details these letters reveal about her work as a mathematician and her experiences during the last days of her life.

Joe Stickles, Millikin University, with Sarah Anderson, Michael Axtell, and Brenda Kroschel, *Domination in Zero-Divisor Graphs of Commutative Rings*
Zero-divisor graphs of commutative rings are well-represented in the literature, and many noteworthy results have been proved by undergraduates. In this talk, we provide a primer of zero-divisor graphs and then consider dominating sets and domination numbers of these zero-divisor graphs. Further, we provide the structure of some minimum dominating sets in the case where the ring is Artinian.

Weihua Li, Columbia College Chicago, with Francieska Boyko, Elizabeth Davis-Berg, Daniel Jordan, Chris Shaw, Arlie Sims, and Eunju Sohn, *Using WeBWorK as a Framework to Build a Fully OER Course*
For good or ill, today's mathematics students rely less on traditional textbooks and instead turn first to the media they have grown up with: short-form video content and online homework with immediate feedback. Without prior context, reading a textbook is often inefficient for students; as a result, when online homework is used in a course, it becomes their primary point of entry, with the textbook consulted only secondarily. However, for many students, particularly those from under-resourced backgrounds, the high cost of online homework systems creates a significant barrier and required course materials are frequently not acquired.

At Columbia College Chicago, we began a project in 2024 to radically and quickly develop open-source materials to be made available free to students. Over one year, and supported by an Illinois state grant, we have deployed our own WeBWorK server and authored a large set of open-source (CC-BY) problems, along with creating an OER text that supports four different multi-section mathematics courses.

In this presentation, we will describe challenges we faced, opportunities for improving the student experience, and feedback from sections we have run.
Any special requests?

Julius Ross, University of Illinois Chicago, *Accessibility for the Working Mathematician*
I will give a short presentation of some aspects of writing accessible documents in light of the upcoming federal regulations that affect state institutions.   This will be an overview aimed at faculty, students and administrators in the mathematical science who may be starting to navigate this topic or who are already in the process of making documents accessible.   I plan to leave time for questions.

Tony Kochev*, Lewis University, *Data-Driven NCAA Volleyball: Exploring Performance Metrics and Ranking Models through Linear Algebra*

This research applies machine learning and advanced linear algebra techniques to model and predict competitive performance in NCAA National Collegiate Men's Volleyball, with a special emphasis on quantifying and incorporating home court advantage. Building upon statistical analysis of four key performance metrics— kills, errors, total attacks, attack percentage —this study confirms the presence of a measurable home court effect across the 2020 through 2025 seasons. Leveraging this insight, we adapt traditional linear-algebra-based ranking models such as the Massey Method by introducing location-based weightings and custom performance feature sets. Through iterative optimization and evaluation against AVCA coaches' polls, we demonstrate that incorporating venue-specific data significantly improves prediction accuracy. Furthermore, we train and validate our models across multiple seasons, showing their ability to generalize over time. The integration of performance analytics, game location, and ranking algorithms illustrates the power of data-driven approaches in capturing the nuanced dynamics of team strength and match outcomes in collegiate volleyball.

Paula R. Stickles, Millikin University, *When The Chalk Dust Settles….Who's Writing the Lesson Plan?*
Generative Artificial Intelligence (AI) is all around us, and there is no doubt that students are using it. While AI offers many possibilities in the field of education, it also has drawbacks and limitations. In this session we will share a lesson planning assignment used in a secondary mathematics methods course that helps students better understand the abilities of AI for teaching and some ways it still has room to grow. We will share students' thoughts and lessons learned.

Msanaa Bosland*, Millikin University, *Graph Planarity Algorithms: Where Paths Cross*
In graph theory, a planar graph is one which can be drawn on a plane while ensuring that no edges are intersecting one another. Graph theory and planarity can be relevant in quite a few real-life applications; one example is the representation of circuit boards as planar graphs, thus being able to determine if a graph is planar is crucial. In this talk, I will present on the importance of planarity, properties of a planar graph, and my progress on designing an algorithm that determines if a graph is planar.

Keven Hansen, Southwestern Illinois College, *What's next for ISMAA? Upcoming Challenges and Opportunities*
This presentation is intended to provide an opportunity for members of the Illinois section to learn more about plans for the future as well as challenges the section is currently facing. Participants will be encouraged to share their own concerns or suggestions for the future of ISMAA.

Minh Phan*, Augustana College, with Andrew Sward *Enumeration of Subgroups of the Stair-step P-group*
We present and prove a recurrence formula for counting subgroups in the family of Abelian groups $\mathbb{Z}_p \times \mathbb{Z}_{p^2} \times \cdots \times \mathbb{Z}_{p^n}$. This approach is not based on partitions or type classifications, but instead provides a direct count of subgroups of a given order p^k.

Markus Jesse*, Millikin University, *Abstracting Algebra: The Life of Emmy Noether*
Amalie Emmy Noether (1882-1935), who went by her middle name Emmy, was a mathematician born to a German Jewish family. Noether's work is oftentimes split into three epochs as described by Hermann Weyl, a fellow mathematician and friend of hers. Her first epoch includes works in differential and algebraic invariants and includes proofs of both Noether Theorems. Invariant theory focuses on expressions that remain constant under a group of transformations, leading to the law of conservation of energy. Noether's second epoch is characterized by her work in ring theory and helped build the foundations of abstract algebra, and the third contains her work in noncommutative algebra and representation theory. In this talk I will cover her early life, contributions, and challenges she faced as a woman in mathematics.

Section Next—Saturday
Christine Jamroz, University of St. Francis
Round-table discussion of all things related to early career faculty.

Contributed Talks—Saturday

Todd D. Oberg, Illinois College, *Meeting the Vision of the Illinois Comprehensive Numeracy Plan in Elementary Education Teacher Preparation*
One of the goals in the Illinois Comprehensive Numeracy Plan is that educators will build and use evidence-based numeracy instructional strategies to strengthen students' mathematical understanding and confidence. In order for this to happen in the elementary grades, pre-service elementary education candidates need to have a deeper, more robust understanding of the mathematics content that they will teach. In this session we will begin exploring the types of experiences these pre-service teachers should have in their mathematics content coursework so that they are prepared to support their future students' numeracy growth.

Hita Bharward*, University of Illinois Chicago, *Group Theory of Garments*
We model garments as compact orientable surfaces with boundary and study their algebraic invariants using the framework of geometric group theory. Relying on foundational results from Clay and Margalit's Office Hours with a Geometric Group Theorist, we interpret garment construction as the formation of free groups, surface groups, amalgamated products, and mapping class group actions. Sewing operations correspond to quotient constructions in fundamental groups, while seam twists correspond to Dehn twists generating mapping class groups. This provides a concrete realization of central constructions in low-dimensional topology.

Kaihua Liu(+), Rachel Rupnow, Northern Illinois University, with Kristen Vroom, Seth Ricarte(+), *What Norms of Mathematical Definitions Can Students Take Away from Instruction?*
Mathematical definitions play a fundamental role in mathematics because they serve as the foundation on which theories are built. Therefore, the practice of creating clear and effective

definitions is essential for further mathematical study. However, the values and expectations behind this practice are often not clearly communicated to students. In this session, we will discuss the results of interviews with five students in one instructor's Ordinary Differential Equations course. Students were shown clips of instruction and asked what about definitions they took away. Results include recognition that concept names give insight and that definition conventions vary between mathematicians, in alignment with what their instructor intended to communicate. They also highlighted the role of definitions in aiding their memory of concepts. In this session, participants will have the opportunity to discuss what they saw in instruction and consider how they might share norms related to definitions in their own instruction.

Hoang Trieu*, Augustana College, *On the Expansion of* $(1 - \zeta_p)^n$
$(1 - \zeta_p)^n$, where ζ_p is a primitive p-th root of unity, plays an important role in representation theory. This presentation introduces two novel formulas for the coefficients of $(1 - \zeta_p)^n$ when expressed as a linear combination of the basis $\{1, \zeta_p, \zeta_p{}^2, \ldots, \zeta_p{}^{p-2}\}$. The first approach utilizes the well-known Binomial Theorem, while the second leverages a combinatorial method that exploits the inherent periodic symmetry of complex numbers. These formulas provide not only a closed-form solution to a classical algebraic problem but also a practical tool for computing conductors within specific ring structures.

Amanda Harsy, Adam Schultze, Michael Smith Lewis University, and Britanny Stephenson, *Analyzing the Impact of Alternate Assessment in Mathematics Courses*
The mindset of a student can determine how well that student will perform academically. Students who primarily have a "fixed mindset" of learning believe one is either good at something or not and that intelligence cannot be nurtured or developed, while students who have a "growth mindset" of learning reflect a belief that through perseverance and effort, one can improve their abilities and intelligence. Instructors can support student development of a growth mindset and academic growth by encouraging and recognizing students for their growth in learning and by using assessment practices that support the idea that through practice and effort, concepts can be understood. In order to support a growth mindset of learning and reduce test anxiety, professors are implementing alternative assessment techniques such as specifications and standards-based grading. This presentation shares results from a multi-institutional collaboration that studies the impact of alternate assessment techniques on the growth mindset of students and their test anxiety in a variety of mathematics courses. By analyzing pre- and post-surveys with questions adapted from Dweck's Mindset survey, we explore whether there is a difference in the growth mindset among various cross-sections of student populations (using alternate versus traditional assessment techniques, different courses, subsets of students, universities, etc.) and whether the growth mindset of students changed by the end of the semester.

Andrew Burley(+), Chicago State University, *Higgs Bundles and the Magic of Matrices*
Higgs bundles are objects with useful applications to many areas of contemporary math research, including mathematical physics. We will explore Higgs bundles as a pair, consisting of a vector bundle E and a Higgs field, Φ. Although geometrically complex, under local trivialization, the

Higgs field break down quite elegantly to represent a matrix A(z) dz. Using linear algebra, we establish an exact 1-1 correspondence between the coefficients of the characteristic polynomial and a 'spectral curve' whose coordinates are the eigenvalues of the Higgs field which manifest as a branched cover of a Riemann surface X. We hope to explore the wonderful elegance of Higgs bundles and their applications.

Katie Brill*, Benedictine University, *Modeling a Seasonal Flu Epidemic with Targeted Mitigation Measures*
Seasonal influenza is a viral respiratory illness responsible for recurring epidemics. While infection with seasonal influenza typically does not result in severe or fatal illness for many, some individuals are at elevated risk of complications due to factors such as age or underlying health conditions. To protect a population from a seasonal influenza epidemic, effective use and allocation of limited resources is important for the mitigation of disease spread. To compare the effect of vaccinations and antiviral treatments administered only to high-risk individuals on the mitigation of a seasonal influenza epidemic, we have developed a system of differential equations with high-risk and low-risk susceptible classes. Through analysis of this model, we discuss results concerning whether vaccines or antivirals are more effective on their own and whether focusing efforts on only high-risk individuals is sufficient to control an epidemic.

James Kwabena Odum(+), Northern Illinois University, *COVID-19 Prediction Trends and Public Health Policy Impact Using Machine Learning*
The COVID-19 pandemic, declared by the World Health Organization on March 11, 2020, caused unprecedented global disruption. This study leverages machine learning (ML) to derive data-driven insights for managing such public health crises. The study employs ML techniques to (1) forecast the trajectory of COVID-19 cases, (2) classify countries based on outbreak severity and patterns, and (3) evaluate the effectiveness of public health interventions. Using a comprehensive dataset from Our World in Data (spanning January 5, 2020, to August 14, 2024), The study applied three distinct analytical approaches. Ridge regression was used for predictive modeling, DBSCAN clustering for country stratification, and Long Short-Term Memory (LSTM) networks benchmarked against Random Forest and ARIMA models to quantify the impact of public health policies. Ridge regression demonstrated exceptional predictive accuracy for case trajectories ($R^2 = 0.999$). DBSCAN clustering optimally grouped countries by outbreak severity, achieving a Silhouette score of 0.75. Furthermore, the LSTM model ($R^2 = 0.95$) proved superior in assessing policy impacts, revealing that stringent interventions in 2021 were strongly correlated with reduced disease transmission, whereas the relaxation of measures in 2022 aligned with subsequent case resurgences. These findings highlight the significant potential of machine learning to analyze pandemic dynamics and evaluate intervention strategies. This approach can provide crucial, data-driven evidence to inform and optimize response efforts in future global health emergencies.

Dung Nguyen*, Elmhurst University, *Gcd-Graphs over Matrix Rings*
Gcd-graphs are well-studied in the literature. These graphs connect various subfields of mathematics including number theory, algebra, combinatorics, and graph theory. In this article,

we define and study gcd-graphs defined over a matrix ring with coefficients in finite fields. We show that these graphs enjoy several interesting graph-theoretic properties.

Angela Antonou, College of DuPage, *Workload Management for Faculty (and Others)*
Faculty are often expected to fulfill many roles and responsibilities within their institution. They are often engaged in teaching, service, and/or scholarship. In any of these buckets, they may have multiple disjoint (or perhaps loosely connected) projects. As the number of projects increases, the need for a project/workload management system does as well. This talk is meant to share some of the techniques I have used over the years to manage my workload. I'll introduce a general structure, following the model of GTD, and I'll share some of my favorite tips/tricks that can be implemented right away. Some of these include how to keep your inbox at empty, how to track tasks on which you are waiting for a response, and how to manage actions that must be completed (whether small individual actions or ones needed to move a project forward). I'll also share some of the technology I use to manage this.

Tung T. Nguyen, Elmhurst University, *Cyclotomic factors of rational necklace functions*
Necklace polynomials arise in various fields of mathematics, including combinatorics, Lie theory, and Galois theory over finite fields. Their arithmetic properties have been extensively studied in recent years. In this talk, we will introduce a new class of rational necklace functions that unifies two well-studied families of polynomials: necklace polynomials and Fekete polynomials. We describe several ways in which cyclotomic polynomials appear as factors of these rational necklace functions. Our results unify and generalize earlier work of Hyde on necklace polynomials and of Chidambaram--Minac--Nguyen--Tan on Fekete polynomials.

Anna Jung*, University of Illinois Chicago, *Generating a Heterogeneous Finite Element Model for Elastography*
Magnetic Resonance Elastography (MRE) is a form of elastography in conjunction with MRI that uses shear waves to map the viscoelastic properties of biological tissue. This is achieved by providing vibrations to a specific biological region and acquiring data of the wave patterns to determine the speed of wave propagation. MRE is a noninvasive technique that offers insight into the stiffness of tissue with high sensitivity and the highest depth penetration compared to other imaging modalities, such as ultrasound and optical imaging. Current theories for elastography are based on homogenization, isotropy, and bulk shear wave motion, which can result in inaccuracies. This project is a numerical approach of heterogeneity in a muscle using finite element analysis to compare with the homogenization theoretical results.

Prem Magar*, Principia College, *Balancing Covariates in Randomized Experiments via Discrepancy Theory*
How should we divide clinical trial participants into treatment and control groups so that the groups are balanced across many characteristics at once? This fundamental question in experimental design leads naturally to the combinatorial discrepancy problem: given a matrix A in $\mathbb{R}^{m \times n}$ encoding subject covariates, minimize $\|Ax\|_\infty$ over all assignments x in $\{-1, +1\}^n$.

A random coin flip for each subject yields imbalance $O(\sqrt{n \log m})$, but Spencer's 1985 theorem — "Six Standard Deviations Suffice" — shows that $O(\sqrt{n})$ is achievable regardless of the number of covariates.

So, here I present Spencer's partial coloring argument, survey the constructive breakthroughs of Bansal and Lovett–Meka, and discuss the Gram-Schmidt Walk algorithm, which achieves near-optimal balance while preserving the randomness necessary for valid hypothesis testing.

Jackson Lewis(+), Southern Illinois University, *Hyperbolic Angular Momentum*
In this work we investigate the structure of angular momentum through the oscillator realization introduced by Schwinger, in which the generators of the su(2) algebra arise from pairs of harmonic oscillator ladder operators. Within this framework an additional set of operators appears naturally which satisfies the su(1,1) algebra, a structure which Schwinger refers to as hyperbolic angular momentum. We first present a graphical visualization of the Schwinger oscillator basis that clarifies and illustrates the action of both the standard angular momentum ladder operators and the hyperbolic operators. In this picture the usual su(2) ladder operators move within a fixed irreducible representation of angular momentum, while the su(1,1) ladder operators move between these irreducible representations of angular momentum and within a fixed irreducible representation of hyperbolic angular momentum. As an application of this structure, we present Schwinger's algebraic derivation of the allowed values of the total angular momentum in the coupling of two spin systems, obtaining the bounds without appealing to the usual dimension-counting argument.

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