~~UNDERGRADUATE MATH SEMINAR~~ Steinmetz Symposium!

In deference to the annual Steinmetz Symposium being held on **Friday, May 9**, there will not be a separate math seminar this week. Instead, we encourage you to attend the math talks and view the math posters that will be presented.

Session 3 — The Templeton Institute Special Session — Olin 115

- **11:30, Ziayan Omer,** In the Shadows of Samarkand: Persia's Lost Mathematicians: Between the 14th and 15th centuries, Persian scholars, such as Ghiyāth al-Dīn Jamshīd Al-Kāshī (under the guidance of the great Timurid Sultan and astronomer/mathematician Ulugh Beg), pioneered iterative mathematical approximation techniques that allowed for highly accurate approximations of sin(1°). These methods were further developed in Mughal-era India in both Persian and Sanskrit texts. This talk, based on ongoing work-study research, describes how we reconstruct these mathematical techniques and implement them computationally to better understand their accuracy and efficiency.

Session 4 — Poster Presentations — Wold Atrium

- **12:30, Shriya Biswas,** Exploring Disparities in Metastatic Breast Cancer Treatment Timeliness: Healthcare inequity is a global challenge, with individuals in low- and middle-income households disproportionately affected by conditions such as metastatic breast cancer, which require timely detection and treatment. This study aims to develop predictive models that promote health equity by using diverse, representative data to identify and address health disparities in cancer care. Specifically, we examine how factors such as socioeconomic status, geographic location, race, gender, and access to healthcare resources influence treatment accessibility and diagnostic timelines. We analyzed a dataset containing 13,173 metastatic breast cancer patient records, including demographics, diagnoses, treatment options, and insurance data. Through exploratory data analysis, ANOVA, and correlation analysis, we investigated how these factors relate to the waiting period for treatment. Our findings revealed that payer type and race significantly influenced the time to treatment, suggesting potential disparities in access to or quality of care. Correlation analysis indicated weak or negligible relationships between metastatic diagnosis periods and individual factors such as age, household median income, and BMI. Addressing these disparities could help improve the equity and quality of cancer care, ultimately reducing differences in treatment timelines and patient outcomes.

Session 6 — Mathematics and Statistics — Bailey 207

- **1:50, Grace Newcombe,** An Audio Analysis Of Elliptic Curves: An elliptic curve is an equation that can be expressed in the form $y^2 = x^3 + ax + b$, where a, b are certain rational constants. They can be expressed mod primes p, and the solutions to these curves in this form can be used to define a specific Fourier series (particular sums of periodic sine and cosine functions). These series can then be audialized using techniques such as additive synthesis in order to hear how they behave. The goal of this thesis is to use additive synthesis to analyze elliptic curve data.
- **2:10, Abby Wilder**, Measuring Transgender Health Disparities The Impact Of Gender-Inclusive Legislation On Health Status, Behaviors, And Healthcare Access: The transgender community experiences pervasive social, political, and economic marginalization which shapes physical and mental health trajectories. Structural barriers to LGBTQ+ competent health services further exacerbate disparities in health outcomes and behaviors. This study analyzes data from the CDC's Behavioral Risk Factor Surveillance System (2020–2022) to assess national disparities in health status, risk behaviors, and healthcare access between transgender and cisgender adults. To investigate the influence of state-level inclusivity on transgender health, state-specific legislative protections of gender identity and the State Equality Index developed by the Human Rights Campaign are incorporated. Findings indicate that transgender respondents are significantly more likely than their cisgender counterparts to report mental health challenges and are less likely to afford and utilize routine healthcare or other necessary services. Poor self-rated general health, frequent physical distress, engagement with risk behaviors (smoking and never exercising), and inability to access healthcare are amplified for (Continued on next page)

transgender people living in states classified as restrictive of the LGBTQ+ community. State-level protections in housing, public accommodations, and education, as well as bans on gender-based health insurance exclusions, are most strongly associated with reduced negative health outcomes and behaviors among transgender respondents. These findings highlight the critical role of inclusive state policies in mitigating health disparities and promoting well-being within the transgender community.

- **2:30**, **Audrey Benson**, Lyapunov Exponent For The Products of Random Matrices Related To An Art Collector Model: We consider a special case of an art collector model recently proposed by Rastegar, Roitershtein, Roytershteyn and Seetharam (2024). The model considers an investor collector who must balance the competing long-term goals of sustainable financial health and maintaining a pleasing art collection. The model studies the exponential growth rate of the long-term value of the assets through the products of random matrices where one of the entries involves a Bernoulli random variable with parameter. This exponential growth rate is known as the Lyapunov exponent. Exact values for Lyapunov exponents are generally difficult to compute, even for simple random matrix models. We give a novel construction of a deterministic sequence of upper and lower bounds that converge to the Lyapunov exponent. This sequence involves a recursion in two variables related to Fibonacci type sequences.
- **2:50**, **Janak Subedi**, Evaluation Of Leading Machine Learning Models: In simple terms, machine learning methods are algorithms that can turn data into meaningful information. Leveraging statistical algorithms and mathematical optimization, machine learning algorithms can use data to understand patterns, make predictions or classifications, and provide useful insights through minimal instructions. This has helped ML find its application in fields like data mining, medical image processing, Natural Language Processing (NLP), finance, and many others. However, ML models come with inherent challenges, including overfitting, interpretability issues, and computational trade-offs, which must be carefully considered to ensure their effectiveness. This study evaluates the performance of three widely used ML models; XGBoost, Random Forests, and Deep Neural Networks; across classification and prediction tasks. To conduct this analysis, three real-world datasets were selected: a credit card default dataset for classification, a real estate sales dataset for property value prediction, and a vehicle sales dataset for price estimation. These datasets provide diverse testing grounds for assessing model accuracy, computational efficiency, and interpretability. Evaluation metrics such as Mean Squared Error (MSE) and R-squared are used for prediction tasks, while F1-score, Kappa Statistics, and Area Under the Curve (AUC) measure classification performance. The findings of this study highlight the trade-offs between different ML models, demonstrating how each model performs under varying data characteristics and problem contexts. This research aims to provide insights into model selection and optimization strategies for practitioners working with structured datasets in finance, real estate, and other fields. By comparing the strengths and weaknesses of these ML approaches, this study contributes to a deeper understanding of how predictive and classification models can be effectively utilized for data-driven decision-making.
- **3:10, Atharv Tekurkar** and **Baibhav Barwal**, Might You Wake Up And Find That Your Bank Has Collapsed? Bank failures can have far-reaching consequences on customers, employees, investors, and the entire financial ecosystem. This is the problem we plan to address in this seminar by exploring the integration of machine learning modeling with the Altman Z-Score - a well-known bankruptcy prediction model - to assess the accuracy of predicting bank failures. Using a dataset of macroeconomic and microeconomic factors for 13 failed and 13 non-failed banks, we built and compared machine learning models like Random Forest, XGBoost, and Neural Networks to determine the most effective approach for predicting financial distress. In this presentation, we will dive into this interesting fusion of statistical analysis, computational techniques, and financial forecasting, offering actionable insights for proactive risk management and strategic decision-making in today's uncertain financial world.

ReUnion Weekend, Friday, May 16, 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.