2026 SIAM Graduate Student Research Day (GSRD)

Speaker Name: Nicholas Appiah

Title: Internationally Diversified Equity ETFs under Stress: Tail Risk and Volatility Regimes
Time: March 25 (3.30PM – 3.50PM)

Abstract: This paper examines how internationally diversified equity exchange-traded funds (ETFs) behave across volatility regimes and extreme market conditions. Using daily data from 2015–2024 for 30 U.S.-listed regional ETFs, we compare an equal-weighted benchmark against optimized long-only and long–short portfolios under mean–variance and conditional value-at-risk (CVaR) criteria. We document pronounced left-tail asymmetry and volatility persistence in ETF returns, with extreme value diagnostics indicating semiheavy tails and volatility models revealing persistent conditional-variance dynamics. Equal-weighted allocations reduce concentration-driven tail exposure, while CVaR-based and long–short strategies improve risk-adjusted performance at the cost of greater sensitivity to stress episodes. Robust regression results indicate strong integration with global market factors, although residual tail risk remains economically significant. To connect the empirical return asymmetry and semi-heavy tails to derivative valuation, we also compute option prices and implied-volatility surfaces under a normal inverse Gaussian (NIG/NDIG) Lévy model that accommodates skewness and semi-heavy tails. Taken together, the findings show that international diversification through equity ETFs mitigates, but does not eliminate, downside risk and that portfolio performance and risk exposures are highly sensitive to volatility regimes.

Speaker Name: Hasitha Nipun

Title: On some algebraic properties of Euler's totient

Time: March 25 (3.50PM – 4.10PM)

Abstract: The main objective of this study is to investigate some group theoretic aspects of Euler's totient which is an important arithmetic function in number theory. We prove some relationships between divisor functions and Euler's totient associate with finite cyclic groups. Finally, we extend the idea of Euler's totient to finite groups.

Speaker Name: Gihani Wickramasinghe

Title: Bayesian Spatial Modeling of Measles Outbreak in Texas, USA

Time: March 25 (4.10PM – 4.30PM)

Abstract: Measles remains a significant public health concern despite the availability of an effective vaccine, with recent outbreaks in Texas illustrating ongoing vulnerabilities in disease control. This study investigates the spatial distribution of measles incidence during the 2025 outbreak period across Texas counties using a Bayesian Zero-Inflated Poisson model with spatial dependence, incorporating a conditional autoregressive prior. The model accounts for the excess zeros in the data, i.e., counties reporting no cases, while capturing spatial correlations and the effects of demographic and environmental covariates, including MMR vaccination rates, population density, temperature, and precipitation. By applying this modeling framework, we estimate key epidemiological metrics such as the standardized incidence ratio, relative risk, and exceedance probabilities to identify high-risk regions. Results highlight a pronounced spatial concentration of elevated measles risk in northwestern Texas, where low vaccination coverage and other contributing factors have led to a severe outbreak.

Keywords: Measles in Texas, Zero-inflated Poisson, Spatial effect, Bayesian inference.

Speaker Name: Dilmi C.W. Hettiachchi-Halpe-Kankanamalage

Title: Tail-Aware Portfolio Optimization for Real Estate ETFs Under Downside Risk

Time: March 25(4.30PM – 4.50PM)

Abstract: This paper develops an integrated empirical framework for analyzing the risk–return structure of real estate exchange-traded fund (ETF) portfolios under non-Gaussian market conditions. Using daily data for 30 U.S. and global real estate ETFs spanning 2021–2024, we study how portfolio outcomes depend on both the optimization criterion and the statistical features of returns that are often obscured by standard mean–variance assumptions. We first construct long-only and long–short portfolios under classical Markowitz mean–variance optimization and tail-sensitive conditional value at risk (CVaR) optimization, and we compare their realized dynamics through cumulative growth and efficient frontiers under alternative risk-free benchmarks. To quantify extreme-risk exposure, we apply extreme value theory using generalized Pareto modeling and Hill tail-index estimation, benchmarked against broader equity market behavior. We then evaluate portfolio stability and reward efficiency using a multidimensional set of risk-adjusted metrics, including volatility, Sharpe, Sortino, and Rachev ratios, maximum drawdown, and information ratio. To characterize common factor dependence and mitigate outlier influence, we estimate robust single-factor regressions of ETF returns on a sector benchmark and assess residual diagnostics. Finally, we incorporate a forward-looking dimension by calibrating a Lévy-based normal inverse Gaussian (NIG) type option-pricing specification and extracting option-implied price and volatility surfaces, linking return asymmetry and volatility clustering to derivative-

implied uncertainty. Across the pipeline, the results consistently indicate that real estate ETF returns exhibit heavy tails, pronounced downside sensitivity, and persistent volatility, implying that tail-aware optimization and robust estimation provide materially different and more informative portfolio diagnostics than Gaussian-based approaches.

Speaker Name: Shakya Ranasinghe

Title: Seed, Structure, and Spread: Topological Insights on Risk Dynamics in Network Pathology.

Time: March 25 (4.50PM – 5.10PM)

Abstract: Risk is an intrinsic part of our daily lives, and measurement is the foundation of assessing risk. It is widely recognized that there are at least three factors that mediate risk in the context of a pathology over a network: (1) where that pathology is seeded within the network; (2) how the network is structured; and (3) what rules, or dynamics, determine the fidelity of network communication within the underlying structure. These principles manifest in a milieu of physiological and social network phenomena, from disinformation moving through social media to Alzheimer's disease proteopathy spreading within the brain. Despite the apparently intuitive nature of these three maxims, it can be challenging to investigate questions of risk in network propagation. To address this, there are two fundamental problems that must be resolved: (1) How to measure a difference between network propagation; and (2) how can we ascribe a risk framework to such a measurements?

This work explores a general framework to determine risk measures associated with network pathology, connecting recent advances in Topological Data Analysis; Persistent Homology and Persistent Representations, and traditional approaches in statistical risk analysis. An illustrative application using a Desikan-Killiany brain connectome in Alzheimer's Disease (AD)-like propagation through binary activations of a Watts threshold model demonstrates how variations in"Seed, Structure, and Spread" may indeed have implications for an aging population, framing neurodegenerative diseases as a combination of propagation processes shaped by the topology of the brain's structural network.

Keywords: risk, topology, network pathology, persistent homology

Speaker Name: Zuhra F. S. Lebbe

Title: Probabilistic Deep Learning for Networks Community Detection

Time: March 25 (5.10PM – 5.30PM)

Abstract: Community detection is a fundamental task in network analysis, with applications across social, biological, and information systems. Although neural network–based techniques have improved clustering performance, most existing approaches rely on point estimates and provide limited insight into the uncertainty associated with network node cluster assignments. This gap in uncertainty quantification restricts interpretability and undermines reliability in downstream decision-making. We propose a framework that integrates neural network–based node embeddings with a mixture of experts statistical model to quantify uncertainty in node clustering. The approach combines representation learning with probabilistic modeling to capture both embedding variability and clustering ambiguity. In particular, we examine how expert-specific components can model heterogeneous cluster structures while yielding principled uncertainty measures for node membership. We conduct simulation studies and empirical analyses on benchmark network datasets to assess clustering performance, as well as the calibration and robustness of the proposed uncertainty measures. Overall, this framework provides a principled, uncertainty-aware approach to node clustering, enabling more reliable network inference and supporting informed decision-making.