MISSOURI S&T

Mathematics & Statistics Colloquium

Wednesday, March 11, 2026, 4:00-5:00 PM
254 Toomey Hall
Refreshments will start at 3:30 PM

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Machine Learning and ESG Integration in Portfolio Optimization: Theory and Evidence

Abstract. This talk extends Azzone et al. [2024] by integrating machine learning (XGBoost), ESG orthogonalization, Monte Carlo equilibrium analysis, and TOPSIS for ESG-constrained portfolio management. We address three key challenges: (i) multicollinearity between ESG and traditional factors via Gram-Schmidt orthogonalization, (ii) return prediction using orthogonalized ESG features (XGBoost R^2 = 8.3% vs. 3.0% linear), and (iii) portfolio optimization with binding ESG constraints. Using Russell 3000 data (2017–2022), we find: (1) ESG mandates improve mean-variance efficiency for moderate return targets (0–4.56%), reconciling ESG with fiduciary duties; (2) the ESG premium is –45 basis points annually, driven by institutional demand rather than risk factors; (3) TOPSIS provides transparent multi-objective portfolio selection. Our integrated framework offers rigorous quantitative tools for sustainable asset management.

Biographical Sketch. **Giuseppe Caristi** is a Full Professor of Mathematics for Economics at the University of Messina, Department of Economics, where he also serves as a member of the Ph.D. Committee in Public Administration Science. He is associate researcher at the Institute for Biomedical Research and Innovation (IRIB), National Research Council (CNR) of Messina. He was formerly Dean of the Bachelor's Degree in Economic Sciences (2009–2015). He has been Visiting Professor at various international institutions including Hagen University (Germany) and the University of Szczecin (Poland). His main research interests include mathematical optimization, nonlinear analysis, and the application of advanced mathematics to economics and decision theory.

David Barilla is Senior Researcher (Associate Professor) of Mathematics for Economics at the University of Messina, Department of Economics, where he also serves as a member of the Ph.D. Committee in Economics, Management and Statistics. He had several collaborators with the Institute for Biomedical Research and Innovation (IRIB), and the National Research Council (CNR) of Messina. He has been Visiting Professor at various international institutions including Hagen University (Germany) and the University of Szczecin (Poland), Łukasiewicz - Poznań Institute of Technology (Poland), Tsinghua University (China), Beijing Forestry University (China). His main research interests include Mathematical Optimization, Nonlinear Analysis, Linear Programming and the Application of Advanced Mathematics to Economics and Decision Theory.