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Ph.D. Dissertation Defense

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Date:	Friday, April 26th, 2024
Time:	12:00 – 2:00 pm
Location:	https://stevens.zoom.us/j/99511423081
Title:	Three Essays on Managing Estimation Risk in Portfolio Selection
Chairperson:	Dr. Zhenyu Cui, Financial Engineering, School of Business
	Dr. Majeed Simaan, Finance/FE, School of Business
Committee Members:	Dr. Zachary Feinstein, Financial Engineering, School of Business
	Dr. Alexander Rodivilov, Economics, School of Business
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Abstract

The three essays presented in my dissertation aim to mitigate the impact of estimation error in portfolio optimization, specifically for the mean-variance strategy proposed by Markowitz.

The first essay, "*Partial Index Tracking Enhanced Mean-Variance Portfolio*" proposes a partial index-tracking strategy that better approaches the true mean-variance portfolio compared with the sample approach. We replace the portfolio variance in the mean-variance optimization with the linear combination of portfolio variance and its tracking error. In order to find the optimal tuning parameter, we take advantage of the Expected Out-of-sample Utility (EOOSU) framework proposed by Kan & Zhou and minimize the mean square error with respect to the true mean-variance rule. The empirical results show that the proposed rule can provide similar performance as the other widely used strategies in literature. In the meantime, it delivers relatively smaller turnover and tracking error compared to other candidates.

The second essay, "*The Economic Value of MSE: Evidence from Portfolio Selection*" follows the same track which studies the importance of mean square error (MSE) in portfolio selection. MSE is the most commonly used statistical loss function because it captures the bias-variance trade-off and allows analytical and numerical treatment. One question remains how much value there is in using MSE in portfolio selection rather than a utility function? We elucidate this question by showing a positive linear relation between the MSE and a portfolio-decision loss function. This relationship provides the foundation for why we use MSE minimization instead of utility maximization to achieve better performance in the first essay and highlights the economic value of generic statistical loss functions.

The third essay, "*Interpret Portfolio Strategies via Shapley Decomposition*" focuses on decomposing the portfolio performance. Though the relationship between portfolio returns and asset returns is inherently linear when expressed as the weighted linear combination, there still exhibits non-linearity due to the interactions between the assets or non-linear risk factors affecting the portfolio. Modern machine learning algorithms can capture this non-linearity, but the complicated structure makes it difficult to interpret. Shapley value in game theory can decompose the expected outcome linearly to each component and overcome the difficulty in machine learning algorithm. It can be applied to subtract weights from portfolio performance or mimic the market index.