Research Statement

Yiyao Luo

My research interests are econometrics and financial econometrics. Through all my projects, I aim to understand the association among data, which is commonly measured by the correlation coefficient. My research seeks answers to the following three questions. In the area of financial econometrics: How can we estimate the correlations precisely when data is observed under contamination, especially in the framework of high-frequency financial data? How do the correlations between returns on any two assets evolve? In the area of econometrics: What are the possible distributions of correlation matrices of dimensions higher than two, and how can we simulate those matrices?

Robust Estimation of Realized Correlation (Job Market Paper) The commonly used correlation estimator, Pearson's sample correlation, is known to be downward biased when applied to high-frequency sampled financial data. Its bias are driven by the presence of microstructure issues, like noise, rounding error, and asynchronous trading. The Pearson estimator is also sensitive to the jumps in prices. Besides, I disclose the bias of Pearson when the returns' volatility are changing within the window of estimation. In this paper, I seek to improve correlation estimates' precision among high-frequency financial data.

I consider two alternative correlation estimators, Quadrant and Kendall, which only use the signs or the ranks of observations. Meanwhile, I suggest a new estimator as a natural extension of the Quadrant estimator, especially for the framework of financial data, called subsampled Quadrant estimator. Subsampled Quadrant estimator keeps the simplicity from Quadrant estimator and has the same level of efficiency as Pearson's sample correlation. I also show the consistency of the subsampled Quadrant estimator when the financial data is associated with time-varying volatility.

In my simulation study, I mimic the microstructure issues and jumps in the prices generating process. The precision of subsampled Quadrant outperforms the other three estimators in all simulation set-ups. Under time-changing volatility, the subsampled Quadrant estimator also exhibits the smallest bias among the estimators of consideration.

As an empirical practice, I propose a new approach to estimate market beta, a measure describes stock's volatility in relation to the overall market, with the use of robust correlation estimators.

On Modeling Dynamic Correlations: A Score-Driven Model In this working paper, I extended my job market paper by updating the appealing features of sign or rank based correlation estimators in forecasting dynamic correlations. In the literature on modeling dynamic correlation coefficients, most of the works have to model volatility first. These works make the choice of volatility model critical and embrace unnecessary computing costs if correlation's motion is the only interest. Consequently, I propose a score-driven model to capture the variation in correlations without estimating volatilities. As another attractive feature of my model, I can naturally plug the nonparametric correlation estimators in my job market paper into the score-driven model as a realized update of correlations bringing benefits such as simplicity and robustness.

A New Method for Generating Random Correlation Matrices (with Peter Reinhard Hansen and Ilya Archakov) Random correlation matrices are commonly used in Bayesian analysis to specify the priors, and are used in frequentist approaches to investigate the properties of estimators and robustness of models. We propose a novel method to generate random correlation matrices. More specifically, the new method allows all pairwise correlations to be distributed identically with more simplicity than existing methods in the literature. Besides, our method can generate correlation matrices with particular structures and properties, such as block correlation matrices. More appealing, it is flexible to control the location and dispersion of the generated correlation matrices with our method. To that end, we can generate perturbations around the empirical correlation matrices to evaluate models in a simulation study.

Moving forward, I look forward to expanding my work on studying the microstructure in financial market, and am excited to continue working on the econometric tools, inclusively but not exclusively for correlations, designed for high-frequency financial data. I hope to contribute to our understanding of the financial market, with the goal to correctly acquire and utilize the information from data.