


复旦大学数学科学学院
数学综合报告会

报告题目：Diffusion Factor Models: Generating High-Dimensional Returns with Factor Structure

报告人：张瑞勋 长聘副教授 (北京大学)

时间：2026-01-07 星期三 10:00-11:00

地点：光华楼东主楼 1801

报告摘要：

Financial scenario simulation is essential for risk management and portfolio optimization, yet it remains challenging especially in high-dimensional and small data settings common in finance. We propose a diffusion factor model that integrates latent factor structure into generative diffusion processes, bridging econometrics with modern generative AI to address the challenges of the curse of dimensionality and data scarcity in financial simulation. By exploiting the low-dimensional factor structure inherent in asset returns, we decompose the score function--a key component in diffusion models--using time-varying orthogonal projections, and this decomposition is incorporated into the design of neural network architectures. We derive rigorous statistical guarantees, establishing nonasymptotic error bounds for both score estimation and generated distribution, primarily driven by the intrinsic factor dimension k rather than the number of assets d, surpassing the dimension-dependent limits in the classical nonparametric statistics literature and making the framework viable for markets with thousands of assets. Numerical studies confirm superior performance in latent subspace recovery under small data regimes. Empirical analysis demonstrates the economic significance of our framework in constructing mean-variance optimal portfolios and factor portfolios. This work presents the first theoretical integration of factor structure with diffusion models, offering a principled approach for high-dimensional financial simulation with limited data. Joint work with Minshuo Chen (Northwestern), Renyuan Xu (Stanford), and Yumin Xu (PKU).

非线性数学模型与方法教育部重点实验室
中法应用数学国际联合实验室
上海市现代应用数学重点实验室
复旦大学数学研究所