

Sookmyung-TMU Mathematical Finance Workshop with Young Researchers

March 8, 2025 (Sat) 12:55–17:30

March 9, 2025 (Sun) 9:00–11:50

Sookmyung Women's University.
Cheongpa-ro 47-gil 100 (Cheongpa-dong 2ga), Yongsan-gu, Seoul, 04310, Korea

Speakers

Takanori Adachi	Tokyo Metropolitan University
Jeonggyu Huh	Sungkyunkwan University
Bong-Gyu Jang	Pohang University of Science and Technology
Younwoo Jeong	Pohang University of Science and Technology
Huixing Jin	Tokyo Metropolitan University
Taegyum Kim	Pohang University of Science and Technology
Natsuno Sawamura	Tokyo Metropolitan University
Kosuke Suzuki	Tokyo Metropolitan University
Kohta Takehara	Tokyo Metropolitan University
Norihiro Tsukamoto	Tokyo Metropolitan University
Kyoko Yagi	Tokyo Metropolitan University
Toshinao Yoshiba	Tokyo Metropolitan University
Tomooki Yuasa	Tokyo Metropolitan University

Scientific Committee

Takanori Adachi	Tokyo Metropolitan University
Huixing Jin	Tokyo Metropolitan University
Yong Hyun Shin	Sookmyung Women's University
Kohta Takehara	Tokyo Metropolitan University
Kyoko Yagi	Tokyo Metropolitan University
Toshinao Yoshiba	Tokyo Metropolitan University
Tomooki Yuasa	Tokyo Metropolitan University

Organized by Research Institute of Natural Science, Sookmyung Women's University,
Research Center for Quantitative Finance, Tokyo Metropolitan University

March 8 (Sat)

12:55–13:00 Opening address by Yong Hyun Shin, Sookmyung Women’s University

Session 1 Chair: Yong Hyun Shin, Sookmyung Women’s University

13:00–13:30 Takanori Adachi Tokyo Metropolitan University
“What if the future is not determined solely by the evolution of this ”now”?”

13:30–14:00 Bong-Gyu Jang Pohang University of Science and Technology
“Household Consumption and Size Structure of Rent”

14:00–14:30 Toshinao Yoshiba Tokyo Metropolitan University
“Dynamic asymmetric tail dependence structure among multi-asset classes for portfolio management: dynamic skew-t copula approach”

Session 2 Chair: Toshinao Yoshiba, Tokyo Metropolitan University

14:45–15:15 Kyoko Yagi Tokyo Metropolitan University
“Earnouts in mergers and acquisitions under asymmetric information”

15:15–15:45 Jeonggyu Huh Sungkyunkwan University
“Improved Deep Learning Methods for Large-Scale Dynamic Portfolio Choice”

15:45–16:15 Kohta Takehara Tokyo Metropolitan University
“Asymptotic expansions as control variates for deep solvers to fully-coupled forward-backward stochastic differential equations”

Session 3 Chair: Kohta Takehara, Tokyo Metropolitan University

16:30–17:00 Tomooki Yuasa Tokyo Metropolitan University
“Second-order unbiased simulation methods for stochastic differential equations”

17:00–17:30 Huixing Jin Tokyo Metropolitan University
“Exploring ETF Anomalies in the Japanese Market”

March 9 (Sun)

Session 4 Chair: Tomooki Yuasa, Tokyo Metropolitan University

9:00–9:30 Kosuke Suzuki Tokyo Metropolitan University
“Analysis of the Relationship Between Trademarks and Firm Value”

9:30–10:00 Younwoo Jeong Pohang University of Science and Technology
“Do event-aware LLMs have predictive capabilities for stocks?”

10:00–10:30 Norihiro Tsukamoto Tokyo Metropolitan University
“A Quantitative Analysis of Market Expectations and Price movements in Japanese Stock”

Session 5 Chair: Huixing Jin, Tokyo Metropolitan University

10:45–11:15 Taegyum Kim Pohang University of Science and Technology
“Bitcoin Price Direction Forecasting and Market Variables”

11:15–11:45 Natsuno Sawamura Tokyo Metropolitan University
“Randomized Markovian approximation for rough volatility models”

11:45–11:50 Closing address by Takanori Adachi, Tokyo Metropolitan University

March 8, 13:00–13:30

What if the future is not determined solely by the evolution of this "now"?

Takanori Adachi

Tokyo Metropolitan University

Markovians believe that the future is determined by “now” except for “probability”. However, they do not answer the question of where those probabilities come from. This talk is a small attempt to answer this question by presenting a framework in which the future is not a “simple” evolution of the present state, but a synthesis of many possible “nows”.

March 8, 13:30–14:00

Household Consumption and Size Structure of Rent

Bong-Gyu Jang

Pohang University of Science and Technology

We develop a model of tenants' rational consumption based on the size of their house. Rent costs per square meter vary across U.S. states, and these structural differences lead to normative outcomes regarding their impact on tenants' consumption behavior. As a result, we highlight that the size structures of rent can have a significant influence on the tenants' optimal consumption choice.

March 8, 14:00–14:30

Dynamic asymmetric tail dependence structure among multi-asset classes for portfolio management: dynamic skew-t copula approach

Toshinao Yoshiba

Tokyo Metropolitan University

This study proposes dynamic AC skew-t copula with cDCC model to capture the dynamic asymmetric tail dependence structure among multi-asset classes (government bonds, corporate bonds, equities, and REITs). We provide new evidence that lower tail dependence coefficients increased compared to upper ones for all pairs in the COVID-19 crash and the recent high inflation period, indicating that the diversification effect through multi-asset investment decreased. Our empirical analysis also shows that in terms of AIC and BIC, dynamic AC skew-t copula fits data of multi-asset classes better than other dynamic elliptical copulas because it can consider the above dependence structure characteristics. Furthermore, out-of-sample analysis reveals that considering an asymmetry of tail dependence structure at each point with an dynamic AC skew-t copula enhances expected shortfall (ES) estimation accuracy and the performance of a minimum ES portfolio. These results indicate that capturing dynamic asymmetric tail dependence is crucial for multi-asset portfolio management. (Joint work with Dr. Kakeru Ito.)

March 8, 14:45–15:15

Earnouts in mergers and acquisitions under asymmetric information

Kyoko Yagi

Tokyo Metropolitan University

Recently, there has been an increase in mergers and acquisitions (M&A) that incorporate earnouts, whereby the acquisition price is paid in stages. An earnout is a contract clause that makes a portion of the acquisition price paid by the acquiring company to the target company conditional on the achievement of financial and other performance targets after the acquisition transaction is completed. This study analyzes the difference between a lump-sum acquisition and an earnout acquisition under complete information. Furthermore, we analyze the impact of earnouts on M&A under asymmetric information between the target and acquiring companies, and verify the effectiveness of earnouts.

This is a joint work with Teruyoshi Suzuki.

March 8, 15:15–15:45

Improved Deep Learning Methods for Large-Scale Dynamic Portfolio Choice

Jeonggyu Huh

Sungkyunkwan University

We present a Pontryagin-Guided Direct Policy Optimization (PG-DPO) method that scales dynamic portfolio choice—including consumption and multi-asset investment—to tens of thousands of risky assets. By combining neural-network controls with Pontryagin’s Maximum Principle (PMP), we avoid intractable dynamic programming (DP) grids, which traditionally cannot handle more than six assets in practice. Instead of approximating the value function (as in deep backward stochastic differential equation (BSDE) methods), we track a policy-fixed adjoint process and align each gradient update with continuous-time PMP conditions. A “one-shot” variant deploys Pontryagin controls after a brief warm-up, often achieving 100–1,000-fold accuracy improvements over naive baselines. Crucially, on modern GPUs, 100,000 iterations typically take under an hour, while a few thousand iterations (often just 1–2 minutes) already yield near-optimal solutions for portfolios with thousands of assets. Numerical experiments confirm consistency with one-asset Merton benchmarks and tractability up to 10,000 assets, surpassing the longstanding DP-based limit of fewer than seven. This enables truly large-scale continuous-time portfolio optimization.

March 8, 15:45–16:15

Asymptotic expansions as control variates for deep solvers to fully-coupled forward-backward stochastic differential equations

Kohta Takehara

Tokyo Metropolitan University

Coupled forward-backward stochastic differential equations (FBSDEs) are closely related to financially important issues such as optimal investment. However, it is well known that obtaining solutions is challenging, even when employing numerical methods. In this paper, we propose new methods that combine an algorithm recently developed for coupled FBSDEs and an asymptotic expansion approach to those FBSDEs as control variates for learning of the neural networks. The proposed method is demonstrated to perform better than the original algorithm in numerical examples, including one with a financial implication. The results show that the proposed method exhibits not only faster convergence but also greater stability in computation. This talk is based on a joint work with Makoto Naito, Taiga Saito and Akihiko Takahashi, which is available on SSRN(id=4947852).

March 8, 16:30–17:00

Second-order unbiased simulation methods for stochastic differential equations

Tomooki Yuasa

Tokyo Metropolitan University

Bally-Kohatsu (2015) and Henry-Tan-Touzi (2017) developed unbiased simulation methods, which are stochastic numerical methods for computing functional values of solutions to stochastic differential equations. The key advantages of unbiased simulation methods are the absence of weak errors and fast computation times. However, the variances of these unbiased estimators are not always finite. To address this issue, Andersson-Kohatsu-Yuasa (2020) introduced a second-order unbiased simulation method with finite variance by applying a second-order method to the infinite series expansion derived from the parametrix method. This study focuses exclusively on the forward-type unbiased simulation method by Bally-Kohatsu (2015). In this talk, we introduce second-order unbiased simulation methods for the backward-type unbiased simulation method by Bally-Kohatsu (2015) and the unbiased simulation method by Henry-Tan-Touzi (2017).

March 8, 17:00–17:30

Exploring ETF Anomalies in the Japanese Market

Huixing Jin

Tokyo Metropolitan University

In the ETF market, a unique mechanism exists to address price discrepancies. Authorized participants (APs), acting as specialized arbitrageurs, correct misalignments between the market price of ETFs and the value of their underlying assets by engaging in creation or redemption activities. Recent studies suggest that creation and redemption flows may reflect underlying non-fundamental demand shocks or inefficiencies.

Building on this research, I examine the characteristics of these ETF anomalies in the context of the Japanese market. My findings confirm the presence of similar anomalies in Japan. Furthermore, by incorporating the Bank of Japan's large-scale ETF purchase policy, where the BoJ's intervention has played a significant role, I explore how these anomalies behave within this unique policy-driven environment.

March 9, 9:00–9:30

Analysis of the Relationship Between Trademarks and Firm Value

Kosuke Suzuki

Tokyo Metropolitan University

Recently, the importance of intangible assets has been increasing with growing attention to trademarks that protect brand value and influence firms' financial characteristics (e.g., Return on Equity, Net Profit Margin) and market valuations (e.g., Market-to-Book Ratio). In this study, we clean data on Japanese trademarks provided by the Japan Patent Office. Using data from 2003 to 2013, we analyze the relationship between the timing of trademark registrations and firm value. Specifically, we confirm that newly registered trademarks positively affect the firm value as they signal the launch of new businesses or products. This study contributes to a deeper understanding of the relationship between trademarks and firm value, offering practical implications for corporate strategy and intellectual property policy.

March 9, 9:30–10:00

Do event-aware LLMs have predictive capabilities for stocks?

Younwoo Jeong

Pohang University of Science and Technology

This study introduces an event-aware forecasting framework that leverages large language models (LLMs) to integrate corporate balance sheet information with real-time news data. Major corporate events—detected and parsed from news sources—are fed into the LLM to dynamically update company-level insights. By employing parameter-efficient finetuning (PEFT) techniques such as Low-Rank Adaptation (LoRA), we refine the LLM’s predictive capabilities without incurring excessive computational costs. Empirical evaluations across multiple industry sectors show that this approach surpasses traditional machine learning baselines, demonstrating robust performance around critical market announcements. These findings highlight the potential of LLM-based methodologies to enhance stock movement forecasting through targeted event-awareness.

March 9, 10:00–10:30

A Quantitative Analysis of Market Expectations and Price movements in Japanese Stock Market

Norihiro Tsukamoto

Tokyo Metropolitan University

Forecasts of the stock market are presented frequently from various sources and are sometimes reported as factors influencing stock price movements. In this paper, we conduct quantitative analyses to explore the relationship between analyst forecasts and stock price movements.

We perform quantile regression to examine the relationship between changes in market forecasts and change in the Nikkei 225 index with a one-week lag to capture the varying effect with the degree of stock price changes. We also adopt several control variables such as U.S. stock indices, USD/JPY exchange rates, domestic interest rates, and stock price volatility.

The empirical results reveals that, during intense stock price fluctuations, forecasts are revised downward beforehand, indicating that market forecasts can be seen as proxy variables reflecting market uncertainty. Additionally, weekly changes in market forecasts exhibit high autocorrelation with a certain degree of trend. Moreover, the relationship with other explanatory variables appears weak, suggesting that market forecasts demonstrate unique behavior.

To examine whether the relationship between forecasts and stock prices has changed over time, we conducted a time-series analysis. A rolling estimation with the past three years of data was conducted, and we found No substantial changes in the relationship between forecasts and stock prices over time.

Furthermore, using QUICK Corporation's monthly survey, in which market forecasts are gathered from investors, we analyzed whether the relationship with stock prices differs by business category, such as sell-side and buy-side analysts. By replacing the market forecast values with these categories and performing quantile regression, we found potential differences in the relationship depending on the business type. However, since these forecast values represent monthly changes, whether similar results can be obtained using daily data from the previous analysis remains an issue for future research.

March 9, 10:45–11:15

Bitcoin Price Direction Forecasting and Market Variables

Taegyum Kim

Pohang University of Science and Technology

This paper aims to improve Bitcoin price direction prediction using a CNN-LSTM model that incorporates various relevant indicators, such as stock market indices, commodity indices, and interest rates. Separate models are trained for predicting price up and down direction and combined to enhance prediction accuracy. We utilize binary classification models to independently analyze the impact of different features, verified through explainable artificial intelligence techniques. Additionally, an investment strategy based on our model is proposed and compared with traditional strategies, specifically focusing on maximum drawdown relative to the S&P500 buy-and-hold strategy. Results suggest that our strategy offers potential for stable investment in Bitcoin, showcasing its value as a financial asset. This study demonstrates the role of deep learning in Bitcoin price direction prediction and investment strategy development, and contributes to future research on cryptocurrency forecasting and investment approaches

March 9, 11:15–11:45

Randomized Markovian approximation for rough volatility models

Natsuno Sawamura

Tokyo Metropolitan University

In rough volatility models, the variance follows a stochastic Volterra equation (SVE) with the fractional kernel, rendering it non-Markovian and non-semimartingale. This poses challenges for efficient numerical computation. The Markovian approximation addresses this issue by approximating the SVE with an n -dimensional diffusion process defined by an ordinary stochastic differential equation. The accuracy of this approximation heavily depends on the selection of weights and nodes, particularly in low-dimensional settings where n is small. This paper introduces a novel stochastic approach based on importance sampling for determining the weights and nodes. Unlike conventional quadrature-based deterministic methods, this approach enables flexible selection for each simulation path even in low-dimensional settings. A numerical experiment using the rough Heston model demonstrates that while the proposed method does not yet surpass BL2, the numerical optimization-based quadrature method, it outperforms all theoretically grounded quadrature methods.