Shimoda Statistical Seminar

Advances in Quantum Statistics and Time Series Analysis

Organizer: Yan Liu (Waseda University)
Date: March 22~23, 2025
Venue: Shimoda Tokyu Hotel (https://www.tokyuhotels.co.jp/shimoda-h/)

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Program

March 22, 2025

20:00 – 20:25 Masanobu Taniguchi (Waseda Univ.)
Adjustments for a Class of Tests Under Nonstandard Condition and its Financial Applications

20:25 – 20:50 Takayuki Shiohama (Nanzan Univ.)
Recent Developments in Complex-valued and Circular Time Series Modeling

20:50 – 21:15 Fumiya Akashi (Univ. of Tokyo)
Convergence of Plug-in Statistics in Spatial Median Regression and Applications to Reduced-Rank and Sparse Empirical Likelihood Estimation

21:15 – 22:00 Presentation by students of Liu's lab (I)

March 23, 2025

08:00 – 08:20 Presentation by students of Liu's lab (II)

08:20 – 08:45 Ying Chen (National Univ. of Singapore)
Hybrid Quantum Neural Networks with Amplitude Encoding: Advancing Recovery Rate Predictions

08:45 – 09:10 Thorsten Koch (Technische Univ. Berlin)
How to Measure Progress?

09:10 – 09:35 Xiaofei Xu (Wuhan Univ.)
Long-memory Log-linear Zero-inflated Generalized Poisson Autoregression for Covid-19 Pandemic Modeling

09:35 – 10:00 Nazgul Zakiyeva (Technische Univ. Berlin)
A Functional Network Autoregressive Model for High-Resolution Forecasting in Energy Networks

Abstract

Akashi, Fumiya

Title: Convergence of Plug-in Statistics in Spatial Median Regression and Applications to Reduced-Rank and Sparse Empirical Likelihood Estimation

Abstract: In this talk, we examine the asymptotic properties of plug-in statistics commonly used in spatial median regression. By incorporating a smoothing method, we propose a modified plug-in statistic and establish sufficient conditions for its convergence. As a practical application, we focus on reduced-rank regression for vector autoregressive models, proving the selection consistency and asymptotic normality of a sparse empirical likelihood estimator. These results highlight the robustness and efficiency of the proposed approach.

Chen, Ying

Title: Hybrid Quantum Neural Networks with Amplitude Encoding: Advancing Recovery Rate Predictions

Abstract: Recovery rate prediction plays a pivotal role in bond investment strategies, enhancing risk assessment, optimizing portfolio allocation, improving pricing accuracy, and supporting effective credit risk management. However, forecasting faces challenges like high-dimensional features, small sample sizes, and overfitting. We propose a hybrid Quantum Machine Learning model incorporating Parameterized Quantum Circuits (PQC) within a neural network framework. PQCs inherently preserve unitarity, avoiding computationally costly orthogonality constraints, while amplitude encoding enables exponential data compression, reducing qubit requirements logarithmically. Applied to a global dataset of 1,725 observations (1996–2023), our method achieved superior accuracy (RMSE 0.228) compared to classical neural networks (0.247) and quantum models with angle encoding (0.242), with efficient computation times. This work highlights the potential of hybrid quantum-classical architectures in advancing recovery rate forecasting. This is a joint work of Ying Chen, Paul Griffin, Paolo Recchia, and Lei Zhou.

Koch, Thorsten

Title: How to Measure Progress?

Abstract: Working in mathematical optimization for over 25 years, I have been asked how much "progress" has been achieved. The first question is how to measure progress, especially as a similar question now arises with the advent of Quantum Computing. Despite

some claims, classic systems still have some advantage compared to what can be done by contemporary quantum-based systems. However, one expects this gap to close and substantial progress to happen. How do we measure where we stand?

We report on a study investigating the progress made in LP and MILP solver performance during the last two decades by comparing the solver software from the beginning of the millennium with the current codes.

We will report on our choices for measuring and compiling performance statistics and on why it is challenging to compute one reasonable number to express performance.

Finally, we will relate this to efforts to compare the performance in this area between classic and quantum systems.

Shiohama, Takayuki

Title: Recent Developments in Complex-valued and Circular Time Series Modeling

Abstract: Since an angular valued time series is expressed as a time series on a unit circle on the complex plane, parameter estimation techniques share some well-known methods in complex-valued data analysis. Recently, several fundamental properties of higher-order circular time series models have been developed, while several problems remain in the parameter estimation for such data. In this study, several parameter estimation procedures are introduced, and their asymptotic properties are discussed. These theoretical findings are verified via a series of Monte Carlo simulations. Finally, some actual circular and/or complex-valued time series data analyses are illustrated.

Taniguchi, Masanobu

Title: Adjustments for a Class of Tests Under Nonstandard Condition and its Financial Applications

Abstract: A general framework for hypothesis testing based on a portmanteau-type test statistic is provided. Sufficient conditions for the proposed test statistic to have an asymptotic chi-squared distribution in terms of the Fisher information matrices are provided, and an adjustment procedure for the test statistic is implemented. The delicate limit behavior of the proposed test is investigated with respect to the local asymptotic power. Finally, the fundamental mechanism of portmanteau type tests is discussed in a unified view. We also deal with the asymptotics related to the likelihood ratio test and the Wald test when the parameter of interest is on the boundary of the parameter space. In this context, the likelihood ratio statistic asymptotically has a mixed $\chi 2$ distribution. We introduce a class S of test statistics which includes the likelihood ratio and the Wald and the Rao statistic, in the

case of observations generated from a general stochastic process. We develop the third-order asymptotic theory for S, prove that Λ is Bartlett adjustable, and derive nonlinear adjustments for the other statistics. Applications for financial problems are given. Numerical studies confirm the benefits of the adjustments on the accuracy and on the power of tests whose statistics belong to S. Cowork with Anna Clara Monti (Univ. Sannio, Italy).

Xu, Xiaofei

Title: Long-memory Log-linear Zero-inflated Generalized Poisson Autoregression for Covid-19 Pandemic Modeling

Abstract: This paper describes the dynamics of daily new cases arising from the Covid-19 pandemic using a long-range dependent model. A new long memory model, LFIGX (Log-linear zero-inflated generalized Poisson integer-valued Fractionally Integrated GARCH process with eXogenous covariates), is proposed to account for count time series data with long-run dependent effect. It provides a novel unified framework for integer-valued processes with serial and long-range dependence (positive or negative), over-dispersion, zero-inflation, nonlinearity, and exogenous variables effects. We adopt an adaptive Bayesian Markov Chain Monte Carlo (MCMC) sampling scheme for parameter estimation. This new modeling is applied to the daily new confirmed cases of Covid-19 pandemic in six countries including Japan, Vietnam, Italy, the United Kingdom, Brazil, and the United States. The LFIGX model provides insightful interpretations on the impacts of policy index and temperature, and delivers good forecasting performance to the dynamics of daily new cases in different countries. This is a joint work with Yijiong Zhang, Yan Liu, Yuichi Goto, Masanobu Taniguchi, and Ying Chen.

Zakiyeva, Nazgul

Title: A Functional Network Autoregressive Model for High-Resolution Forecasting in Energy Networks

Abstract: In this talk, we introduce a functional network autoregressive model proposed for studying large-scale network time series observed at high temporal resolution. The model incorporates high-dimensional curves to capture both serial and cross-sectional dependence in large-scale network functional time series. Estimation of the model is approached using a Mixed Integer Optimisation method. Simulation studies confirm the consistency of parameter and adjacency matrix estimation. The method is applied to data from a real-life natural gas supply network of more than 1,000 nodes. Compared to alternative prediction models, the proposed model delivers more accurate day-ahead hourly out-of-sample forecasts of the gas inflows and outflows at most gas nodes.