Waseda International Symposium

Topological Data Science, Causality & Time Series Analysis

Date: February 27 – 28, 2020

Venue: Nishi-Waseda Campus, Waseda University
Building 55N, Meeting Room 2, 2nd floor
(Access map: https://www.waseda.jp/fsci/en/access/)

Organizer: Masanobu TANIGUCHI
(Research Institute for Science & Engineering, Waseda University)

Supported by:

- JSPS KAKENHI Kiban (S) Grand-in-Aid No. 18H05290 (M. Taniguchi)
- Waseda Research Institute for Science & Engineering
  Institute for Mathematical Science

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Program

February 27

14:20–14:30: Masanobu Taniguchi (Waseda University)
Opening

14:30–15:10: Yan Liu (Waseda University)
Statistical Inference for Persistence Landscapes of the Granger Causality

15:10–15:25: Coffee break

15:25–16:10: Rainer von Sachs (Université catholique de Louvain)
Intrinsic wavelet regression for curves of Hermitian positive definite matrices

16:10–17:00: Discussion on Data Science & Statistics
(i) ***A short history of international collaboration***
by Masanobu Taniguchi (Waseda University)

(ii) *Recent developments for data science*

February 28

10:00–10:30: Yuichi Goto (Waseda University)
Estimation of Trigonometric Moments for Circular Distribution of MA(p) Type by Using Binary Series

10:30–11:10: Kou Fujimori (Waseda University)
Moment convergence of the generalized maximum composite likelihood estimators for determinantal point processes

11:10–11:30: Coffee Break

11:30–12:10: Fumiya Akashi (University of Tokyo)
Robust regression on hyper-spheres with unspecified heteroscedastic errors and smooth approximation of object functions

12:10–14:50: Lunch Time

14:50–15:35: Ying Chen (National University of Singapore)
Regularized Partially Functional Autoregressive Model

15:35–16:20: Christian Francq (ENSAE)
Count and duration time series with equal conditional stochastic and mean orders

16:20–16:40: Coffee Break

16:40–17:30: Discussion on Data Science & Statistics

18:00– Buffet Party

Abstracts

February 27 (14:20–17:00)

Yan Liu

Title: Statistical Inference for Persistence Landscapes of the Granger Causality

Abstract: We propose a topological approach to statistically analyzing the Granger causality. Granger introduced his celebrated new measure of causality in the sense of prediction errors of multivariate time series 50 years ago. We localize his idea and construct a theory based on locally stationary processes for its alternative version, a natural refinement for stationary processes by Hosoya. To construct the theory, we provide a Gaussian approximation of the suprema of empirical spectral processes. Especially, the local extension of the theory serves for the statistical inference for the Granger causality curve. In addition, we provide a bootstrap procedure for the approximation to construct confidence bands. Finally, we discuss the persistence diagrams and persistence landscapes for the causality curves and numerically construct some examples of locally stationary processes for our simulations studies. (Joint work with Akitoshi Kimura, Masanobu Taniguchi and Hernando Ombao)

Rainer von Sachs

Title: Intrinsic wavelet regression for curves of Hermitian positive definite matrices

Abstract: Intrinsic wavelet transforms and wavelet estimation methods are introduced for curves in the non-Euclidean space of

Hermitian positive definite matrices, with in mind the application to Fourier spectral estimation of multivariate stationary time series. The main focus is on intrinsic average-interpolation wavelet transforms in the space of positive definite matrices equipped with an affine-invariant Riemannian metric, and convergence rates of linear wavelet thresholding are derived for intrinsically smooth curves of Hermitian positive definite matrices. In the context of multivariate Fourier spectral estimation, intrinsic wavelet thresholding is equivariant under a change of basis of the time series, and nonlinear wavelet thresholding is able to capture localized features in the spectral density matrix across frequency, always guaranteeing positive definite estimates. The finite-sample performance of intrinsic wavelet thresholding is assessed by means of simulated data and compared to several benchmark estimators in the Riemannian manifold. Further illustrations are provided by examining the multivariate spectra of trial-replicated brain signal time series recorded during a learning experiment.

Masanobu Taniguchi

Title: A short history of international collaboration

Abstract: This talk delivers a short history of development for collaborative research over 15 years based on JSPS fundings (M.Taniguchi). The related researchers are Puri, M.L., Hallin, M., Garderen, K.J., Lee, S., Veredas, D., DiCiccio, T., Monti, A.C., Petkovic, A., Patilea, V., Giraitis, L., Taqqu, M., Chen, C.W.S., Pewsey, A. etc. Integrating these collaborative research, we have published four English books. Some future view will be provided in relation to Waseda symposium.

Yuichi Goto

Title: Estimation of Trigonometric Moments for Circular Distribution of MA(p) Type by Using Binary Series

Abstract: Directional statistics have received a great deal of interest in recent years, and a variety of distributions on the circle have been proposed. In this talk, we propose circular distributions of a moving average model of order p type which includes the cardioid distribution, and discuss estimation of trigonometric moments based on binary series. We give an explicit form of the root n consistent estimator based on clipped series, which enables us to construct an efficient estimator by the Newton--Raphson iterative method. We also show a robustness of the proposed estimator when the probability density function is contaminated with a noise term.

Kou Fujimori

Title: Moment convergence of the generalized maximum composite likelihood estimators for determinantal point processes

Abstract: The maximum composite likelihood estimator for parametric models of determinantal point processes (DPPs) is discussed. Since the joint intensities of these point processes are given by determinant of positive definite kernels, we have the explicit form of the joint intensities for every order. This fact enables us to consider the generalized maximum composite likelihood estimator for any order. In this talk, we introduce the two-step generalized composite likelihood estimator and shows the moment convergence of the estimator under a stationarity. Moreover, our results can yield information criteria for statistical model selection within DPPs. (Joint work with Sota Sakamoto and Yasutaka Shimizu)

Fumiya Akashi

Title: Robust regression on hyper-spheres with unspecified heteroscedastic errors and smooth approximation of object functions

Abstract: Statistical treatment for a random vector on a hyper-spheres attracts a lot attention recently, and has various applications such as seismic wave analysis, analysis for orientation of wild fire, etc. In this talk the nonlinear regression model whose predictor is a random vector on a hyper-sphere is considered. It is well known that the classical method in “linear statistic” does not work for spherical random vectors. To construct a robust estimator for the nonlinear regression function, this talk employees L1-regression method and kernel-type objective function. The proposed local-linear estimator has asymptotic normality even if the error process has infinite variance, dependent structure or heteroscedasticity. The smooth approximation of the L1 objective function is also proposed. Some simulation experiments illustrate desired finite sample properties of the proposed method. (Joint work with Holger Dette)

Ying Chen

Title: Regularized Partially Functional Autoregressive Model

Abstract: We propose a partially functional autoregressive model (pFAR) to describe the dynamic evolution of serially correlated functional data. This model provides a unified framework to depict both the serial dependence on multiple lagged functional covariates and the associated relation with ultrahigh-dimensional exogenous scalar covariates. Estimation is conducted under a two-layer sparsity assumption, where only a small number of groups and elements are supposed to be active, yet their number and location are unknown in

advance. We establish the asymptotic properties of the estimator and perform simulation studies to investigate its finite sample performance. We demonstrate the application of the pFAR model using daily natural gas flow curves data in the high pressure pipeline of German gas transmission network. The gas demand and supply are influenced by their historical values and 85 scalar covariates varying from price to temperature. The model provides insightful interpretation and good out-of-sample forecast accuracy compared to several popular alternative models. (Joint work with Thorsten Koch and Xiaofei Xu)

Christian Francq

Title: Count and duration time series with equal conditional stochastic and mean orders

Abstract: We consider a positive-valued time series whose conditional distribution has a time-varying mean, which may depend on exogenous variables. The main applications concern count or duration data. Under a contraction condition on the mean function, it is shown that stationarity and ergodicity hold when the mean and stochastic orders of the conditional distribution are the same. The latter condition holds for the exponential family parametrized by the mean, but also for many other distributions. We also provide conditions for the existence of marginal moments and for the geometric decay of the beta-mixing coefficients. We give conditions for consistency and asymptotic normality of several estimators of the conditional mean parameters which do not require fully specifying the conditional distribution. We compare Quasi-Maximum Likelihood Estimators (QMLEs) (in particular the Poisson QMLE and the Exponential QMLE) and weighted least squares estimators. Simulation experiments and illustrations on series of stock market

volumes and of greenhouse gas concentrations show that the multiplicative-error form of usual duration models deserves to be relaxed, as allowed in our approach. (Joint work with Abdelhakim Aknouche)