Kinosaki Seminar

Data Science & Causality

Date: Feb.28- Mar.2, 2019

Venue: Blue Ridge Hotel（https://www.blridge.jp/english）

Organizer : Masanobu Taniguchi (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 (*speaker)

February 28

16:00–17:00: Master Course Theses (Supervisor: M.Taniguchi)
Willy Lukito Winata, Yuta Araki, Satoshi Tokunaga, Hiroshi Hashimato, and Yuichi Goto

20:00–20:30:
The variable selection by the Dantzig selector for Cox's proportional hazards model
Kou Fujimori* (Waseda University)

20:30–21:00:
Modified LASSO estimators for linear quantile regression models with long-memory disturbances
Yujie Xue* (Waseda University)

21:00–21:30:
James-Stein type estimators for time series
Yoshiyuki Tanida* (Waseda University) and Masanobu Taniguchi

March 1

9:00–9:30:
Granger causality of irregular sampled time series
Akitoshi Kimura* (Waseda University)

9:30–10:00:
Hybrid GEL test for rotational symmetry on spheres
Fumiya Akashi* (Research Institute for Science and Engineering, Waseda University)

10:00–10:30:
A historical note on the Stirling and Eulerian numbers
Xiaoling Dou* (Faculty of Science and Engineering, Waseda University) Hsien-Kuei Hwang (Institute of Statistical Science, Academia Sinica)

10:50–11:20:

A simple algorithm for a multivariate skew-normal model
Toshihiro Abe* (Nanzan University) and Hironori Fujisawa

11:20–11:50:
Local Asymptotic Normality and Efficient Estimation for Multivariate INAR(p) Models
Hiroshi Shiraishi* (Keio University)

Lunch

13:00–13:30:
Joint convergence of sample autocovariance matrices when ¥lowercase{$p/n ¥to 0$} with application.
Arup Bose* (Indian Statistical Institute, Kolkata)

13:30–14:00:
Portmanteau-Type Tests for Unit-root and Co-integration
Ngai Hang Chan* (Department of Statistics, The Chinese University of Hong Kong)

14:00–14:30:
Relevant change points in high dimensional time series
Holger Dette* (Ruhr-Universitaet Bochum)

14:30–15:00:
Standard testing procedures for white noise and heteroskedasticity
V. Dalla, Liudas Giraitis* (Queen Mary University of London) and PCB Phillips

15:30–16:00:
Non Gaussian models for fMRI data
Alessandra Luati* (University of Bologna)

16:00–16:30:
Regular variation and heavy-tail large deviations for time series
Thomas Mikosch* (University of Copenhagen)

16:30–17:00:
Regularized Estimation of High Dimensional Auto- and Cross-Covariance Matrices
Tommaso Proietti* (University of Rome, “Tor Vergata”)

Mar 2

9:30–10:00:
Prediction of singular VARs and application to generalized dynamic factor models
Siegfried Hörmann* (Graz University of Technology)

10:00–10:30:
Levy driven Ornstein-Uhlenbeck type processes and intermittency
Murad S. Taqqu* (Boston University)

11:00–12:00: Discussion

Abstracts

Title: The variable selection by the Dantzig selector for Cox's proportional hazards model
Author: Kou Fujimori* (Waseda University)
Abstract: The proportional hazards model proposed by D. R. Cox in a high-dimensional and sparse setting is discussed. The regression parameter is estimated by the Dantzig selector, which will be proved to have the variable selection consistency. This fact enables us to reduce the dimension of the parameter and to construct asymptotically normal estimators for the regression parameter and the cumulative baseline hazard function.
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Title: Modified LASSO estimators for linear quantile regression models with long-memory disturbances
Author: Yujie Xue* (Waseda University)
Abstract: It is the fundamental task of statistics to find out internal relationship of diversity of scientific observations. Quantile regression offers the opportunity for a more complete view of the relationships among stochastic variables. In this talk, the properties of modified LASSO estimators for linear quantile regression models is discussed when the disturbances are long-memory which implies the dependence on the disturbances before decays very slowly. We derive the asymptotic distributions of the estimators when there is no nonzero parameter and also derive the property of the estimators when nonzero parameters exist under some appropriate regularity conditions. Furthermore, when the dimension of parameters increases with respect to n, the consistency on the probability of the correct selection of penalty parameters is shown under certain regularity conditions.
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Title: James-Stein type estimators for time series
Author: Yoshiyuki Tanida* (Waseda University) and Taniguchi
Abstract: This paper introduces James-Stein type estimators (JST) for the mean of p dimensional Gaussian stationary processes. The JST estimators are written in terms of a shrinkage function $¥phi(¥cdot)$, and includes the sample mean and the James-Stein estimator as special cases. We evaluate the mean squared error of JST estimators for the mean when the observations are generated from a Gaussian vector stationary process when $p>2$. We compare the MSE of JST with that of the sample mean. Then a sufficient condition for the proposed JST estimators to improve upon the sample mean is given in terms of $¥phi(¥cdot)$ and the spectral density matrix at the origin. We also seek

$¥phi(¥cdot)$ which gives the largest improvement for the difference of MSE between JST and the sample mean. Simulation experiments are given, and we observe that the proposed JST estimator performs well in the sense of MSE. The results have a potential to improve the usual estimators in a variety of time series data in application.
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Title: Granger causality of irregular sampled time series
Author: Akitoshi Kimura* (Waseda University)
Abstract: Granger causality is a concept of inference about the cause-effect relationships in the time series. The test is usually applied to the regular sampled time series. In real world applications, the time series are not always regularly sampled. In this talk, we introduce some existing papers and some ideas dealing with the theme.
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Title: Hybrid GEL test for rotational symmetry on spheres
Author: Fumiya Akashi* (Research Institute for Science and Engineering, Waseda University)
Abstract: This talk considers a nonparametric test for rotational symmetry of directional data. Most of classical density functions on the unit spheres share the common important feature called rotational symmetry. However, recently some authors found real data which do not satisfy this condition, and Ley and Verdebout (J. Multivariate Anal. 2017, 159:67-81) proposed a family of skew-rotationally-symmetric distributions on spheres. On the other hand, it is often severe to assume certain parametric family for real data. To overcome such hurdle, this talk employees a measure of skewness proposed by Mardia (Biometrika 1970, 57(3):519-530), and uniformity test proposed by Watson (1983, Wiley) for projected observations. This talk integrates these two methods into a hybrid-type generalized empirical likelihood statistic for the rotational symmetry test. Unlike the classical research, the proposed method does not require any parametric assumption for the underlying model. Some simulation experiments also illustrate finite sample performance of the proposed method.
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Title: A historical note on the Stirling and Eulerian numbers
Author: Xiaoling Dou* (Faculty of Science and Engineering, Waseda University) Hsien-Kuei Hwang (Institute of Statistical Science, Academia Sinica)
Abstract: The Stirling and Eulerian numbers have been studied extensively in a large number of diverse areas. While the history of the developments of these numbers in the West has

been largely and factually clarified, that in the East has remained mostly obscure. In this work, we aim to provide more historical materials during the Edo Period concerning these numbers, and to specially shed further light on their evolution (including introduction and use) in the Wasan History. We found that unlike the early developments of these numbers in the West, Japanese mathematicians in the Edo Period were motivated not merely by computational but also combinatorial problems.
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Title: A simple algorithm for a multivariate skew-normal model
Author: Toshihiro Abe* (Nanzan University) and Hironori Fujisawa
Abstract: Among recent various skew normal distributions, the most fundamental distribution dates back to Azzalini (1985). Though the skew normal distributions were proposed more than 30 years ago, there is still no simple method for parameter estimation. Among various skew normal distributions, we consider a statistical inference for the (multivariate) skew normal distributions based on Azzalini's perturbation in this talk.
We introduce a overparameter into probabilistic expression using special trick, to derive the well-known skew normal distributions and successfully express the EM algorithm explicitly. Since the algorithm is given in a simple explicit expression, the numerical computation is easible even for high dimensional data set. Finally, numerical results for our EM algorithm are shown and compared with an existing method.
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Title: Local Asymptotic Normality and Efficient Estimation for Multivariate INAR(p) Models
Author: Hiroshi Shiraishi* (Keio University)
Abstract: We derive the Local Asymptotic Normality (LAN) property for Multivariate Integer-valued autoregressive (INAR) process with order p. Moreover, by using LAN property, we propose an efficient estimaton method for the parameter. Our procedure is based on the one-step method, which updates an initial n^1/2-conssitent estimator into an efficient one. This yields a computationally attractive and statistically efficient estimator.
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Title: Joint convergence of sample autocovariance matrices when ¥lowercase{$p/n ¥to 0$} with application.
Author: Arup Bose* (Indian Statistical Institute, Kolkata)
Abstract: Consider a high dimensional linear time series model where the dimension p and the sample size n grow in such a way that $p/n ¥to 0$. Let $¥hat{¥Gamma}_u$ be the uth order sample autocovariance matrix.

We first show that the LSD of ¥textit{any} symmetric polynomial in $¥{¥hat{¥Gamma}_u, ¥hat{¥Gamma}_u^{*}, u ¥geq 0¥}$ exists under independence and moment assumptions on the driving sequence together with weak assumptions on the coefficient matrices. This LSD result, with some additional effort, implies the asymptotic normality of the trace of any polynomial in $¥{¥hat{¥Gamma}_u,¥hat{¥Gamma}_u^{*}, u ¥geq 0¥}$. We also study similar results for several independent MA processes.
We show applications of the above results to statistical inference problems such as in estimation of the unknown order of a high-dimensional MA process and in graphical and significance tests for hypotheses on coefficient matrices of one or several such independent processes.
This is joint work with Monika Bhattacharjee.
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Title: Portmanteau-Type Tests for Unit-root and Co-integration
Author: Ngai Hang Chan* (Department of Statistics, The Chinese University of Hong Kong)
Abstract: This paper proposes a new portmanteau-type statistic by combining several lags of the sample autocorrelations to test for the presence of a unit-root of an autoregressive model. The proposed method is nonparametric in nature, which is model free and easy to implement. It avoids modeling the fitted residuals and does not require estimation of nuisance parameters, as commonly done in the augmented Dickey-Fuller or Phillips-Perron procedure. Asymptotic properties of the test are established under general stationary conditions on the noises. Finite sample studies are also reported to illustrate the superior power of the proposed method. Applications to test for co-integration are also given.
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Title: Relevant change points in high dimensional time series
Author: Holger Dette* (Ruhr-Universitaet Bochum)
Abstract: This paper investigates the problem of detecting relevant change points in the mean vector of a high dimensional time series, which means that in at least one component of the vector the (absolute) difference between the means before and after the change point is larger than a given threshold. This formulation of the testing problem is motivated by the fact that in many applications a modification of the statistical analysis might not be necessary, if the differences between the parameters before and after the change points in the individual components are small.
We propose a new test for this problem based on the maximum of squared and integrated CUSUM statistics and investigate its properties as the sample size and the dimension of the time series both converge to infinity. In particular, using Gaussian approximations for the

maximum of a large number of dependent random variables, we show that on certain points of the boundary of the null hypothesis a standardised version of the maximum converges weakly to a Gumbel distribution. Moreover, a multiplier bootstrap procedure is proposed, which improves the finite sample performance of the test.
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Title: Standard testing procedures for white noise and heteroskedasticity
Author: V. Dalla, Liudas Giraitis* (Queen Mary University of London) and PCB Phillips
Abstract: Commonly used tests to assess evidence for the absence of serial correlation between time series in applied work rely on procedures whose validity holds for i.i.d. data. When the series are not i.i.d., the size of correlogram and cumulative Ljung-Box tests can be significantly distorted. This paper adapts standard correlogram tests to accommodate hidden dependence and non-stationarities involving heteroskedasticity, thereby uncoupling these tests from limiting assumptions that reduce their applicability in empirical work. To enhance the Ljung-Box test for non i.i.d. data a new cumulative test is introduced. Asymptotic size of these tests is unaffected by hidden dependence and heteroskedasticity in the series. An extensive Monte Carlo study confirms good performance in both size and power for the new tests. Applications to real data reveal that standard tests frequently produce spurious evidence of serial correlation.
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Title: Non Gaussian models for fMRI data
Author: Alessandra Luati* (University of Bologna)
Abstract: Functional magnetic resonance imaging (fMRI) is a non invasive technique for collecting data on brain activity. The outcomes of fMRI measurements are complex data that can be interpreted as multivariate time series, recorded at different brain locations, usually across subjects. The brain imaging literature has been mainly concerned with task-based fMRI analysis, where the interest lies in the response to controlled exogenous stimuli. Nevertheless, resting state fMRI (RfMRI) analysis, dealing with spontaneous brain activity, is considered the key to understand the neuronal organisation of the brain.
To identify spontaneous neural activations and to estimate the brain response function in RfMRI data, we apply a novel method, based on robust signal extraction. A score driven model is specified for RfMRI data, where the noise is allowed to be non Gaussian, and the signal may account for non stationary dynamics. Likelihood inference is carried out and brain connectivity at the region level is explored. (Joint work with Francesca Gasperoni)
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Title: Regular variation and heavy-tail large deviations for time series

Author: Thomas Mikosch* (University of Copenhagen)

Abstract: The goal of this lecture to present some of the recent results on heavy-tail modeling for time series and the analysis of their extremes.

Over the last 10-15 years research in extreme value theory has focused on the interplay between the serial extremal dependence structure and the tails of time series. In this context, heavy-tailed time series (as appearing in finance, climate research, hydrology, and telecommunications) have been studied in detail, leading to an elegant probabilistic theory and statistical applications.

Heavy tails of the finite-dimensional distributions are well described by multivariate regular variation: it combines power-law tails of the marginal distributions and a flexible dependence structure which describes the directions at which extremes are most likely to occur; see Resnick (2007) for an introductory text to multivariate regular variation.

A second line of research has continued through the years but attracted less attention: heavy-tailed large deviations. In the 1960s and 1970s A.V. and S.V. Nagaev started studying the probability of the rare event that a random walk with iid heavy-tailed step sizes would exceed a very high threshold far beyond the normalization prescribed by the central limit theorem. In the case of subexponential (in particular regularly varying) distributions the tail of the random walk above high thresholds is essentially determined by the maximum step size. Later, related results were derived for time series models by Davis and Hsing (1995), Mikosch and Wintenberger (2014,2016), among others. Here the main difficulty is to take into account clustering effects of the random walk above high thresholds.

Regular variation and heavy-tailed large deviations are two aspects of dependence modeling in an extreme world. They are similar in the sense that they are closely related to the weak convergence of suitable point processes. Actually, both regular variation and heavy-tail large deviations are defined via the vague convergence of suitably scaled probability measures whose (infinite) limit measure has interpretation as the intensity measure of a Poisson process. In the heavy-tailed time series world this relationship opens the door to the Poisson approximation of extreme objects such as the upper order statistics of a univariate sample, the largest eigenvalues of the sample covariance matrix of a very high-dimensional time series, and to functionals acting on them.

References

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Title: Regularized Estimation of High Dimensional Auto- and Cross-Covariance Matrices
Author: Tommaso Proietti* (University of Rome, "Tor Vergata")
Abstract: The estimation of the (auto- and) cross-covariance matrices of a stationary random process plays a central role in prediction theory and time series analysis. When the dimension of the matrix is of the same order of magnitude as the number of observations and/or the number of time series, the sample crosss-covariance matrix provides an inconsistent estimator. In the univariate framework, we proposed an estimator based on regularizing the sample partial autocorrelation function, via a modified Durbin-Levinson algorithm that receives as an input the banded and tapered sample partial autocorrelations and returns a consistent and positive definite estimator of the autocovariance matrix; also, we established the convergence rate of the regularized autocovariance matrix estimator and characterised the properties of the corresponding optimal linear predictor.
The talk presents and discusses the multivariate generalization, which is based on a regularized Whittle algorithm, shrinking the lag structure towards a finite order vector autoregressive system (by penalizing the partial canononical correlations), on the one hand, and shrinking the cross-sectional covariance towards a diagonal target, on the other. As the shrinkage intensity increases, the multivariate system converges to a set of unrelated univariate processes. We illustrate the merits of the proposal with respect to the problem of out of sample prediction and the estimation of the spectral density of high-dimensional time series.
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Title: Prediction of singular VARs and application to generalized dynamic factor models
Author: Siegfried Hörmann* (Graz University of Technology)
Abstract: Vector autoregressive processes (VARs) with innovations having a singular covariance matrix (in short singular VARs) appear naturally in the context of dynamic factor models. The Yule-Walker estimator of such a VAR is problematic, because the solution of

the corresponding equation system tends to be numerically rather unstable. For example, if we overestimate the order of the VAR, then the singularity of the innovations renders the Yule-Walker equation system singular as well. Moreover, even with correctly selected order, the Yule-Walker system tends be close to singular in finite sample. In this paper we are going to show that this has a severe impact on predictions. While the asymptotic rate of the mean square prediction error (MSPE) can be just like in the regular (non-singular) case, the finite sample behaviour is suffering. This effect will be reinforced, if the predictor variables are not coming from the stationary distribution of the process, but contain additional noise. Again, this happens to be the case in context of dynamic factor models. We will explain the reason for this phenomenon and show how to overcome the problem. Our numerical results underline that it is very important to adapt prediction algorithms accordingly.
This talk is based on joint work with Gilles Nisol (ULB).
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Title: Levy driven Ornstein-Uhlenbeck type processes and intermittency
Author: Murad S. Taqqu* (Boston University)
Abstract: Superpositions of Ornstein-Uhlenbeck type (supOU) processes form a rich class of stationary processes with a flexible dependence structure. The asymptotic behavior of the integrated and partial sum supOU processes can be, however, unusual. Their cumulants and moments turn out to have an unexpected rate of growth. We identify the property of fast growth of moments or cumulants as intermittency, expressed here as a change-point in the asymptotic behavior of the absolute moments.
This is joint work with Danijel Grahovac, Nikolai N.Leonenko and Alla Sikorskii.
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