Workshop on Recent Progress

in Time Series:

in honour of Peter Robinson

Program and Abstracts

May 29–30, 2019

Large meeting room on 4F

Graduate School of Economics and Management

Tohoku University

Program

Wednesday, May 29, 2019

13:00-14:00   **Peter M Robinson (LSE)**: Long-Range Dependent Curve Time Series' (joint work with Degui Li and Han Lin Shang)

14:15-15:45   **E. Kurozumi (Hitotsubashi Univ.):** Asymptotic Properties of Bubble Monitoring Tests

T. Kurita (Fukuoka Univ.)：Modelling and forecasting the dollar-pound exchange rate in the presence of structural breaks (written with Jennifer　L. Castle, University of Oxford)

Y. Yajima (Tohoku Univ.): On Gaussian semiparametric estimaiton for two-dimeinsional intrinsic stationary random fields

16:00-17:10   **Y. Hosoya (Tohoku Univ.)**：Extending the concepts of interdependence beyond the stationary time series

M. Shintani (Univ. Tokyo)：Frequency-wise causality analysis in infinite order vector autoregressive processes

Banquet

Wednesday, May 30, 2019

9:30-10:30   **Y. Konishi (RIETI)**：Zipf's and Gibrat's Laws for Tourist Flows in Japan: 2011-2017

Y. Nishiyama (Kyoto Univ.): Sequential Unit Root Test Joint work with Kohtaro Hitomi and Keiji Nagai

10:45-11:45   **H. Nishino (Hiroshima Univ.)**：Estimation for ARMA models with t-distributed innovations

Y. Liu (Kyoto Univ.)：Testing structure of dependence for high-dimensional time series based on bootstrap

12:00-13:00   **M. Matsui (Nanzan Univ.)**：Applications of Distance Correlation to Time Series

Y. Matsuda (Tohoku Univ.)：Bivariate CARMA random fields

Abstracts

Peter M Robinson: London School of Economics

'Long-Range Dependent Curve Time Series' (joint work with Degui Li and Han Lin Shang)

Abstract:
We introduce methods and theory for functional or curve time series with long range dependence. The temporal sum of the curve process is shown to be asymptotically normally distributed, the conditions for this covering a functional version of fractionally integrated autoregressive moving averages. We also construct an estimate of the long-run covariance function, which we use, via functional principal component analysis, in estimating the orthonormal functions spanning the dominant sub-space of the curves. In a semiparametric context, we propose an estimate of the memory parameter and establish its consistency. A Monte-Carlo study of finite sample performance is included, along with two empirical applications. The first of
these finds a degree of stability and persistence in intra-day stock returns. The second finds similarity in the extent of long memory in incremental age-specific fertility rates across some developed nations.

Eiji Kurozumi, Hitotsubashi University

Asymptotic Properties of Bubble Monitoring Tests

Abstract:
We investigate bubble monitoring tests by extending Phillips, Wu, and Yu (2011) and Phillips, Shi, and Yu's (2015) sup-ADF and generalized sup-ADF tests to the monitoring scheme. We also consider applying the CUSUM detector as proposed by Homm and Breitung (2012). We derive the limiting distributions of the detecting statistics under the null hypothesis, the moderate deviation alternative, and the local alternative. We find that although the moderate deviation alternative shows the difference in the divergence rates of the ADF- and CUSUM-type detectors, the local asymptotic theory is more useful for understanding their differences in detail. We also conduct finite sample

simulations and confirm that the local asymptotic theory approximates the finite sample properties of the tests very well.

Takamitsu Kurita, Fukuoka University

Modelling and forecasting the dollar-pound exchange rate in the presence of structural breaks (written with Jennifer L. Castle, University of Oxford)

Abstract:
We employ a newly-developed partial cointegration system allowing for level shifts to examine whether economic fundamentals form the long-run determinants of the dollar-pound exchange rate in an era of structural change. The paper uncovers a class of local data generation mechanisms underlying long-run and short-run dynamic features of the exchange rate using a set of economic variables that explicitly reflect the central banks' monetary policy stances and the influence of a forward exchange market. The impact of the Brexit referendum is evaluated by examining forecasts when the dollar-pound exchange rate fell substantially around the vote.

Yoshihiro Yajima, Tohoku University

On Gaussian semiparametric estimaiton for two-dimeinsional intrinsic stationary random fields

Abstract:
We propose a Gaussian semiparametric estimator for semiparametric models of two-dimensional intrinsic stationary random fields (ISRFs) observed on a regular grid and derive its asymptotic properties.

Originally this estimator is an approximate likelihood estimator in a frequency domain for long memory models of stationary and nonstationary time series(Robinson(1995.Ann.Statist.); Velasco(1999.J.Time Ser. Anal.)). We apply it to two dimensional ISRFs. These ISRFs include a fractional Brownian field, which is a Gaussian random field and is used to model many physical processes in space.

The estimator is consistent and has the limiting normal distribution as the sample size

goes to infinity. We conduct a computational simulation to compare the performance of it with those of different estimators.

Yuzo Hosoya, Tohoku University

Extending the concepts of interdependence beyond the stationary time series

Abstract:
The measures of one-way effect, reciprocity, and association are defined in the frequency domain typically for vector stationary time series ([3]). The basic idea is elicitation of a one-way effect component of a supposedly causing series and expressing its contribution in reduction of the prediction error by means of the Szegö representation formula of the one-step ahead prediction error of stationary processes. To define a partial version of the measures of interdependence, the paper [4] suggested the third-effect elimination of the one-way effect component of the third series from a pair of subject-matter series so that temporal sequence character of interdependence between series in question is least distorted. The present paper proposes extension of those concepts and allied measures to processes such as:

(i)   Nonstationary cointegrated processes ([5]),

(ii)   Locally stationary processes introduced by ([1]),

(iii)   Doubly-parametrized stationary time series and stationary fields ([2], [6]).

Extension to (i) is enabled by introduction of an auxiliary generating process. Regarding (ii), the measures of interdependence is generalized to locally stationary vector processes by extension of Dahlhaus' block shifting method and the allied asymptotics. The extension to the case (iii) and hence to nontemporal processes is enabled by application of the Szegö formulas of the prediction error in prediction based on the half plane and the allied subspace for higher-dimensional fields.

References:

[1] Dahlhaus, R. (1996). Stochastic processes and their Applications, 62, 139-164.

[2] Helson, H. and Lowdenslager, D. (1958). Acta Mathematics, 99, 165-202.

[3] Hosoya, Y. (1991). Probability Theory and Related Fields, 88, 429-444.

[4] Hosoya, Y. (2001). Journal of Time Series Analysis, 22, 537-554.

[5] Hosoya, Y. et al. (2017). Characterizing Interdependencies of Multiple Time Series: Theory and Application, Springer.

[6] Whittle, P. (1954). Biometrika, 41, 434-449.

Mototsugu Shintani, The University of Tokyo

Frequency-wise causality analysis in infinite order vector autoregressive processes

Abstract:
This paper derives the asymptotic properties of frequency-domain causality measure using the vector autoregressive model of infinite order and proposes a test for causality at a particular frequency.   Simulation results confirm that our procedure works well with sample size typically available in practice. We illustrate the usefulness of our method via an application to financial data.

Yoko Konishi, RIETI

Zipf's and Gibrat's Laws for Tourist Flows in Japan: 2011-2017

Abstract:
Since 2012, importance of tourism industry in Japan has been increasing due to an unprecedented inbound tourism boom. This paper examines the size, rank and growth rates and study whether Zipf's and Gibrat's laws strike Japan's tourist flows. Our analysis reveals that both the ranks and the sizes for Japanese travelers are stable, while the numbers of inbound travelers of each region have higher growth rates and fluctuate in rank order. From Gibrat's regression, we find regions with smaller number of inbound travelers tend to attract more foreign tourists.
This indicates that they keep growing toward a steady state.

Yoshihiko Nishiyama, Kyoto University

Sequential Unit Root Test
K. Hitomi, K. Nagai and Y. Nishiyama

Abstract:
Motivated by Lai and Siegmund (1983), we consider unit root tests under sequential

sampling for an AR(1) process against both stationary and explosive alternatives. We can straightforwardly use the uniform asymptotic normality of their sequential OLS estimator for the test. We find that it is also possible to use the stopping time for this purpose. From this finding, we propose three kinds of test using t value, stopping time and their combination by Bonferroni. To examine the statistical properties, we obtain their weak joint limit by approximating the processes in D[0,¥infty) and a DDS (Dambis and Dubins-Schwarz) Brownian motion. To the best of our knowledge, this is the first attempt to derive the joint weak limit of the estimator and the stopping time in sequential analysis. The distribution of the stopping time is characterized by a Bessel process of dimension 3/2 with and without drift, while the estimator is asymptotically normally distributed as Lai and Siegmund (1983) show. We implement Monte Carlo simulations to examine the small sample properties of the tests.

Haruhisa Nishino, Hiroshima University

Estimation for ARMA models with t-distributed innovations

Abstract:

The standard ARMA model assumes that its innovations are white noise processes with 0 mean and a constant variance. That is, the ARMA model is a second-order stationary process characterised by its autocovariance function. The white noise process has no information about its fourth-order moment. To estimate the ARMA model, we assume a Gaussian process and a Gaussian likelihood. On the other hand, the literature of financial time series tells that the financial returns have fatter tails than Gaussian ones. The Student t-distribution is a typical fat-tailed distribution. The fat-tailed property is related to the fourth order moment. We thus consider that estimation for ARMA models with t-distributed innovations is useful for analysing financial time series. If we know the degree of freedom of the t-distribution of the model, can we estimate the parameters of the ARMA model more efficiently than the Gaussian likelihood? Besides, the talk proposes a preliminary estimate for the degree of freedom based on the method of moments, since the application of MLE for the degree of freedom has a severe problem.

Yan Liu, Kyoto University

Testing structure of dependence for high-dimensional time series based on bootstrap

Abstract:
The problem of testing the sphericity hypothesis for the covariance matrix of high-dimensional time series is considered. It has been shown that the test statistic for sphericity under the null hypothesis is asymptotically normal for high-dimensional time series models. However, the asymptotic variances of the test statistic are different from each other if the time series models are different. To alleviate the computational complexity and model dependence, we propose a bootstrap procedure for the test statistic. The validity and the consistency of the proposed method are justified from the asymptotic theory. The performance is illustrated by simulation studies.

Muneya Matsui, Nanzan University

Applications of Distance Correlation to Time Series

Abstract:
Applications of empirical characteristic functions have been investigated from 70s, which include estimations in certain parametric models and goodness of fit tests of various distributions. More recently, they have been used to measure dependence and to test independence. The distance covariance and correlation, developed by Szekely et al. (2007) and Szekely and   Rizzo (2009) are perhaps the best known statistics for such purpose. Our talk is about applications of these ideas to   stationary univariate and multivariate time series to measure lagged auto- and cross-dependence in a time series. Assuming strong mixing, we establish the relevant asymptotic theory for the sample auto- and cross-distance correlation functions. We also apply the auto-distance correlation function (ADCF) to the residuals of an autoregressive processes as a test of goodness of fit. Under the null that an autoregressive model is true, the limit distribution of the empirical ADCF can differ markedly from the corresponding one based on an iid sequence.
  Time permitting, we also explain the basic idea of applying the distance covariance/correlation to continuous-time processes.
This is joint work with Richard Davis (Columbia), Thomas Mikosch (Copenhagen) and Phyllis Wan (Rotterdam).

Yasumasa Matsuda, Tohoku University

Bivariate CARMA random fields

Abstract:
Brockwell and Matsuda (2017) extended CARMA models for time series to those for random fields, which we call as "CARMA random fields". In this talk, we consider a bivariate extension of CARMA random fields to analyze spatially scattered bivariate observations. After defining bivariate CARMA random fields, we introduce Whittle likelihoods to estimate the parameters with applications to imputation for missing components of bivariate observations. There is a gap between discrete observations and continuous models that needs to be accounted to conduct the imputation. We employ Bayesian ways to fill the gap. We demonstrate them by applying bivariate CARMA random fields to precipitation and temperature data observed at around 7000 irregularly scattered points in US continent.

List of Participants

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Eiji Kurozumi (Hitotsubashi University)
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