Bernoulli Society Satellite Meeting to the ISI World Statistics Congress 2013

"Asymptotic Statistics and Related Topics: Theories and Methodologies"

Sanjo Conference Hall, The University of Tokyo, Tokyo, Japan
2-4 September 2013

Program version: September 1, 2013

Aim and Scope

Recent developments in statistics require stronger tie-ups and integration of various research areas such as asymptotic decision theory, stochastic analysis, asymptotic distribution theory, computational statistics, stochastic numerical analysis, statistical software, machine learning, and applied fields. Topics in asymptotic statistics and related fields will be discussed comprehensively in this meeting:

- Stochastic analysis and limit theorems
- Theory of asymptotic inference and its applications
- Stochastic numerical analysis and computational statistics
- Insurance mathematics and risk theory
- Statistical learning theory

Sponsors

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Organizers

Satoshi KURIKI (Institute of Statistical Mathematics)
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Hiroki MASUDA (Kyushu University)
Yasutaka SHIMIZU (Osaka University)
Taiji SUZUKI (Tokyo Institute of Technology)
Masayuki UCHIDA (Osaka University)
Nakahiro YOSHIDA (The University of Tokyo)

September 2 (Mon.)

∗ All sessions of this day will be held at Auditorium.

9:25–9:30 Opening

9:30–10:30 Invited talks (Chair: Nakahiro YOSHIDA)

Yury KUTOYANTS (Université du Maine)
On approximation of the backward SDE

Naoto KUNITOMO (University of Tokyo)
A robust estimation of integrated volatility under micro-market adjustments and round-off errors

10:45–11:45 Invited talks (Chair: Ryozo MIURA)

Pranab K. SEN (University of North Carolina)
Rank tests for short memory stationarity

Stefano M. IACUS (University of Milan)
On estimation for the fractional Ornstein-Uhlenbeck process observed at discrete time

11:45–13:00 Lunch

13:00–14:00 Invited talks (Chair: Masayuki UCHIDA)

Chenxu LI (Peking University)
Estimating jump-diffusions using closed-form likelihood expansions

Mathieu ROSENBAUM (Université Paris 6)
Estimating the efficient price from the order flow: a Brownian Cox process approach

14:15–15:15 Invited talks (Chair: Taiji SUZUKI)

Arnak S. DALALYAN (ENSAE ParisTech, CREST)
Minimax testing of a composite null hypothesis defined via a quadratic functional in the model of regression

Noboru MURATA (Waseda University)
Learning ancestral atom of structured dictionary via sparse coding

15:30–16:30 Invited talks (Chair: Taiji SUZUKI)

Tsuyoshi UENO (Japan Science and Technology Agency)
Semiparametric statistical approach to reinforcement learning

Hidetoshi SHIMODAIRA (Osaka University)
Higher-order accuracy of multiscale double-bootstrap resampling for testing regions

September 3 (Tue.)

∗ All single sessions of this day will be held at Auditorium.

9:00–10:00 **Invited talks** (Chair: Satoshi KURIKI)

Donald RICHARDS (Pennsylvania State University)
Counting and locating multiple solutions of estimating equations

Yoshihiro YAJIMA (University of Tokyo)
On statistical inference of spatio-temporal random fields

10:15–11:45 **Invited talks** (Chair: Hiroki MASUDA)

Arturo KOHATSU-HIGA (Ritsumeikan University)
LAMN property for jump type processes

Yasushi ISHIKAWA (Ehime University)
Nerve cell model and asymptotic expansion

Alexei M. KULIK (Institute of Mathematics of Ukrainian National Academy of Sciences)
Limit theorems and statistical inference for ergodic solutions of Lévy driven SDE's

11:45–13:50 **Lunch**

13:50–14:20 **Invited talk** (Chair: Sangyeol LEE)

Siyun PARK (Korea University Business School)
Entropy-based test for time series models

14:35–15:15 **Contributed talks (Parallel sessions)**

Auditorium, 14:35–15:15 (Chair: Yasutaka SHIMIZU)

K. K. THAMPI (Mahatma Gandhi University)
Finite time ruin probability of the compound renewal model with constant interest rate and weakly negatively dependent claims

Lakhana WATTHANACHEEWAKUL (Maejo University)
Modified Box-Cox transformation and manly transformation with failure time data

Room 201, 14:35–15:15 (Chair: Masaaki FUKASAWA)

Atsushi TAKEUCHI (Osaka City University)
Asymptotic behavior of densities for stochastic functional differential equations

Yuta KOIKE (University of Tokyo)
Estimation of integrated covariances in the simultaneous presence of nonsynchronicity, noise and jumps

15:30–16:30 Contributed talks (Parallel sessions)

Auditorium, 15:30–16:30 (Chair: Nakahiro YOSHIDA)

Yoshihiko MAESONO (Kyushu University)
Smoothing of sign test and approximation of its p-value

Eric BEUTNER (Maastricht University)
Central and non-central limit theorems for statistical functionals based on weakly and strongly dependent data

Dedi ROSADI (Gadjah Mada University)
Second-order least-squares estimation for regression models with autocorrelated errors: asymptotic properties and simulation results

Room 201, 15:30–16:30 (Chair: Kengo KAMATANI)

Kengo KATO (University of Tokyo)
Gaussian approximations and multiplier bootstrap for maxima of sums of high-dimensional random vectors

Yoichi NISHIYAMA (Institute of Statistical Mathematics)
On Entropy-martingale methods in statistics

Ryosuke NOMURA (University of Tokyo)
The convergence limit of the temporal difference learning

September 4 (Wed.)

∗ All sessions of this day will be held at Auditorium.

9:00–10:30 **Invited talks** (Chair: Yasutaka SHIMIZU)

Manuel MORALES (University of Montreal)
On Lévy insurance risk models: a review and new directions

Hailiang YANG (The University of Hong Kong)
Nonparametric estimate of the ruin probability in a pure-jump Lévy risk model

Hideatsu TSUKAHARA (Seijo University)
On a resampling scheme for empirical copulas

10:45–11:45 **Contributed talks** (Chair: Kengo KAMATANI)

Deniz TASCI (Hacettepe University)
Two independent sample test for folded normal data

Serpil AKTAS (Hacettepe University)
Performance of power divergence statistics under quasi independence model

Kentaro TANAKA (Tokyo Institute of Technology)
Machine learning methods for conditional independence inference

11:45–13:00 **Lunch**

13:00–14:00 **Contributed talks** (Chair: Donald RICHARDS)

Wataru KUMAGAI (Tohoku University)
Quantum hypothesis testing for Gaussian states

Shuhei MANO (Institute of Statistical Mathematics)
Extremes of Pitman's random partitions and their asymptotics

Satoshi KURIKI (Institute of Statistical Mathematics)
Goodness-of-fit statistics based on multifold integrated empirical distribution functions

14:00 **Closing**

On approximation of the backward SDE

Yu.A. KUTOYANTS

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Abstract

We consider the problem of approximation of the solution of the backward stochastic differential equation (BSDE) in the Markovian case. These type equations attract attention of specialists in financial mathematics. See, for example, the work El Karoui N., Peng S. and Quenez M. (1997) *Backward stochastic differential equations in finance*, Math. Finance, 7, 1-71. We suppose that the forward equation depends on some unknown finite-dimensional parameter and therefore the exact solution of the problem does not exist. Our goal is to present an asymptotically efficient estimators of the solution of BSDE. We study this problem in two situations. The first one corresponds to stochastic differential equation with *small noise*. This part is a joint work with L. Zhou (Kutoyants and Zhou, *On Approximation of the Backward Stochastic Differential Equation,* submitted, arXiv:1305.3728). The second problem is devoted to the case of *large samples*, when the time of observations tends to infinity. In both cases the structure of the solution is quite close. We use the family (with respect to the unknown parameter) of solutions of the corresponding PDE and replace the unknown parameter by the one-step MLE. Then we show that in both problems we have the lower minimax bounds on the mean square risk of all estimators of the solution of BSDE. Then we verify that the proposed estimators are asymptotically efficient in the sense of these bounds. To construct the one-step MLE we introduce a *period of learning*, when in the beginning of observations it is possible to have a consistent and asymptotically normal preliminary estimator. Then we improve this estimator up to asymptotically efficient using the one-step MLE procedure. The proofs are based on the smoothness of the solution of the PDE and on the asymptotic properties of the preliminary and one-step MLE in these situations. Especially we need the convergence of moments of estimators to show their asymptotic efficiency.

In the case of linear forward equation it is possible to write the solution of PDE in explicit form. This allows us to give an example of the construction of the estimator of the solution and therefore illustrate the obtained general results.

A robust estimation of integrated volatility under micro-market adjustments and round-off errors

Naoto KUNITOMO

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Abstract

For estimating the integrated volatility by using high frequency data, Kunitomo and Sato (2008a,b) have proposed the Separating Information Maximum Likelihood (SIML) method when there are micro-market noises. The SIML estimator has reasonable finite sample properties and asymptotic properties when the sample size is large under general conditions with non-Gaussian processes or volatility models. We shall show that the SIML estimator has the robustness properties in the sense that it is consistent and has the stable convergence (i.e. the asymptotic normality in the deterministic case) when there are micro-market noises, micro- market (non-linear) adjustments and the round-off errors with the underlying (continuous time) stochastic process. The SIML estimation has also reasonable finite sample properties under these effects.

This is a joint work with Seisyo Sato.

Rank tests for short memory stationarity

Pranab K. SEN

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Abstract

The term short memory is used as synonymous to weakly dependence or short range dependence and is implemented through a strong mixing condition. A rank test for null hypothesis of short memory stationarity possibly after linear detrending is proposed. This test statistics is analogous to the popular KPSS statistic based on cumulative sums but involve their ranks. For the trend-stationarity, the same rank statistic is applied to the residuals of a Theil-Sen regression on a linear trend. The asymptotic distribution of the Theil-Sen estimator under short-memory errors is derived and incorporated in these aligned rank tests. Generalization to general rank tests is also considered. Asymptotic relative efficiency results have been studied in detail along with extensive numerical studies. (The article is to appear in the Journal of Econometrics in 2013)

This is a joint work with Matteo M. Pelagatti, University degli studi di Milano Bicocca.

On estimation for the fractional Ornstein-Uhlenbeck process observed at discrete time

Stefano Maria IACUS

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Abstract

In this talk we propose consistent and asymptotically Gaussian estimators for the parameters λ, σ and H of the discretely observed fractional Ornstein-Uhlenbeck process solution of the stochastic differential equation $dY_t = -\lambda Y_t dt + \sigma d W_t^H$, where $(W_t^H, t \geq 0)$ is the fractional Brownian motion. For the estimation of the drift λ, the results are obtained only in the case when $\frac{1}{2} < H < \frac{3}{4}$. This talk also presents ready-to-use software for the `R` statistical environment based on the YUIMA package.

Estimating jump-diffusions using closed-form likelihood expansions

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Abstract

Jump-diffusions are widely used as models for the time evolution of various quantities exhibiting both sudden and relatively milder changes, e.g., economic phenomena such as financial market crashes. We propose a closed-form expansion for transition density of jump-diffusion processes, for which any arbitrary order of corrections can be systematically obtained through a generally implementable algorithm. As an application, likelihood function is approximated explicitly and thus employed in a new method of approximate maximum-likelihood estimation for jump-diffusion process from discretely sampled data. Numerical examples and Monte Carlo evidence for illustrating the performance of density asymptotic expansion and the resulting approximate MLE are provided to demonstrate the wide applicability of the method. Based on the theory of Watanabe-Yoshida (1987, 1992), the convergence related to the density expansion and the approximate estimation are theoretically justified under some standard sufficient conditions.

Estimating the efficient price from the order flow: a Brownian Cox process approach

Mathieu ROSENBAUM

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Abstract

At the ultra high frequency level, the notion of price of an asset is very ambiguous. Indeed, many different prices can be defined (last traded price, best bid price, mid price, . . .). Thus, in practice, market participants face the problem of choosing a price when implementing their strategies. In this work, we propose a notion of efficient price which seems relevant in practice. Furthermore, we provide a statistical methodology enabling to estimate this price from the order flow.

This is joint work with Sylvain Delattre and Christian Y. Robert.

Minimax testing of a composite null hypothesis defined via a quadratic functional in the model of regression

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Abstract

We consider the problem of testing a particular type of composite null hypothesis under a nonparametric multivariate regression model. For a given quadratic functional Q, the null hypothesis states that the regression function f satisfies the constraint $Q[f] = 0$, while the alternative corresponds to the functions for which $Q[f]$ is bounded away from zero. On the one hand, we provide minimax rates of testing and the exact separation constants, along with a sharp-optimal testing procedure, for diagonal and nonnegative quadratic functionals. We consider smoothness classes of ellipsoidal form and check that our conditions are fulfilled in the particular case of ellipsoids corresponding to anisotropic Sobolev classes. In this case, we present a closed form of the minimax rate and the separation constant. On the other hand, minimax rates for quadratic functionals which are neither positive nor negative makes appear two different regimes: "regular" and "irregular". In the "regular" case, the minimax rate is equal to $n^{-1/4}$ while in the "irregular" case, the rate depends on the smoothness class and is slower than in the "regular" case. We apply this to the problem of testing the equality of Sobolev norms of two functions observed in noisy environments.

Learning ancestral atom of structured dictionary via sparse coding

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Abstract

In sparse coding, signals are represented with a linear combination of a small number of elementary signals called atoms, and the collection of atoms is called a dictionary. Design of the dictionary has strong influence on the signal approximation performance. To put prior information into dictionary learning, several methods imposing a certain kind of structure on the dictionary are proposed. In our approach, like wavelet analysis, a dictionary for sparse signal representation is assumed to be generated from an ancestral atom, and a method for learning the ancestral atom is proposed. The proposed algorithm updates the ancestral atom by iterating dictionary update in unstructured dictionary space and projection of the updated dictionary onto the structured dictionary space. The algorithm allows a simple differential geometric interpretation. Numerical experiments are performed to show the characteristics and advantages of the proposed algorithm.

Semiparametric statistical approach to reinforcement learning

Tsuyoshi UENO

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Abstract

One of important issues in reinforcement learning (RL) is to analyze statistical properties of estimating the value function which evaluates the expected cumulative reward received from a given state. In this talk, we propose a novel framework, semiparametric statistical inference, to the value function estimation problem, and address some open issues for statistical estimation properties in the value function estimation by using estimating function theory, which is well-established toolbox in statistics.

Higher-order accuracy of multiscale double-bootstrap resampling for testing regions

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Abstract

A simple way for computing an approximate p-value of hypothesis testing is the bootstrap resampling. By generating many bootstrap replicates of data, we may count how many times the null hypothesis holds for them. This frequency, known as bootstrap probability, is used widely in applications of life sciences since Felsenstein (1985). The null hypothesis is rejected when the bootstrap probability is smaller than a specified significance level, say, 0.05.

The bootstrap probability works as an approximate p-value. However, it is often reported as "biased" and there have been several attempts for improving the accuracy. One such an attempt is the double-bootstrap of Hall (1992). This method adjusts the bias by bootstrapping the bootstrap probability. The bias is defined as the difference between the rejection probability and the significance level. We say an approximately unbiased test is k-th order accurate if the bias reduces as $O(n^{-k/2})$ asymptotically as the sample size n becomes larger. Efron and Tibshirani (1998) showed that the bootstrap probability is first order accurate, and the double-bootstrap is third-order accurate.

Another attempt for adjusting the bootstrap probability is the multiscale bootstrap of Shimodaira (2004). Let m be the sample size of bootstrap replicates, and $\sigma^2 = n/m$. Typically, $m = n$ ($\sigma^2 = 1$), but we will use several values of m in a similar way as the m-out-of-n bootstrap of Bickel et al. (1997) and Politis and Romano (1994). We then extrapolate the bootstrap probability to $m = -n$ ($\sigma^2 = -1$). This multiscale bootstrap turns out to be third-order accurate for a multivariate normal model.

In this talk, I will propose multiscale-double bootstrap, which adjusts the multiscale bootstrap by the double bootstrap. I will show that this new method is fourth-order accurate for the multivariate normal model. This method is robust to the error of parameter estimation; the asymptotic accuracy of the new method remains fourth-order although that of double bootstrap becomes only second-order.

We work on a multivariate normal model with unknown expectation parameter vector. The null hypothesis is represented as an arbitrary-shaped region with smooth boundaries. This formulation of hypothesis testing is called as the problem of regions in Efron and Tibshirani (1998). Geometry of boundary surfaces such as the signed distance, the mean curvature, and even the mean curvature of the mean curvature play important roles for the asymptotic theory. For proving the fourth-order accuracy, expressions of the asymptotic expansion tend to be very complicated yet the computations are often straightforward. I devised a way of the proof by combining techniques of Shimodaira (2004) and Shimodaira (2008) so that the proof becomes simpler.

Counting and locating multiple solutions of estimating equations

Donald RICHARDS

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Abstract

Multivariate statistical inference leads frequently to score equations, or more generally to estimating equations, which have multiple solutions. Examples of such equations arise in the Behrens-Fisher problem, in estimation of the mean vector and covariance matrix of a multivariate normal population with non-monotone incomplete data, in variance component models, in mixture transition distribution model for Markov chains, and in many other problems. We describe the difficulties inherent in counting the multiple roots of such equations, and we will describe how methods from the theory of algebraic geometry have been applied to resolve some of these problems. Further, we will describe a powerful computational approach, called polynomial homotopy continuation, for locating all roots of these equations.

On statistical inference of spatio-temporal random fields

Yoshihiro YAJIMA

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Abstract

We consider statistical inference based on estimation of spectral density functions for both stationary random fields and random fields with stationary increments. We discuss asymptotic properties of estimators of spectral density functions and testing procedures for various hypotheses like isotropy and separability.

LAMN property for jump type processes

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Abstract

We provide some ideas on how to prove the LAN property for solutions of stochastic differential equations driven by Levy type processes. These results are based on current research carried out with Eulalia Nualart (UPF) and Tran Ngoc Khue (University Paris 13).

Nerve cell model and asymptotic expansion

Yasushi ISHIKAWA

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Abstract

We introduce a stochastic model associated with the Hodgkin-Huxley nerve cell model. We make an asymptotic expansion of this model with respect to the noise parameter.

Limit theorems and statistical inference for ergodic solutions of Lévy driven SDE's

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Abstract

We develop an extension of the "martingale approach" ([1], [2]) for proving averaging principle and diffusion approximation type theorems (that is, functional versions of LLN and CLT) for functionals of ergodic Markov process. Within this extension, the Itô formula is systematically replaced by the *extended Dynkin formula* ([3], [4]), which makes the whole approach insensitive w.r.t. the structure of the process X, and relying only on ergodic assumptions for X and auxiliary moment bounds. Particularly, the limit theorems we obtain are well designed for the case with the Markov perturbation given by a solution to a Lévy driven SDE. In this case, both moment bounds and ergodic rates can be verified efficiently ([5], [6]).

Using these limit theorems, we preform an asymptotical analysis of the statistical model with discretely observed solution to a Lévy driven SDE. We prove Uniform Local Asymptotic Normality of the model and asymptotic normality of the Maximum Likelihood Estimator, extending for Markov models the approach by Ibragimov-Khasminskii [7]. The proof involves substantially the Malliavin-type representations for the likelihood function, its derivative, and their ratio.

References

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Entropy-based test for time series models

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Abstract

Goodness of fit(gof) tests measure the degree of agreement between the distribution of an observed random sample and a theoretical distribution. Over the years, a number of gof methods including the chi-squared test and various empirical distribution function(edf) tests have been developed by many researchers. At the same time, measures of entropy, divergence, and information are also applied in gof tests. In time series analysis, the gof test problem has been a crucial issue for modelling time series. In particular, the normality test attracted much attention from many researchers, since the normality of time series guarantees several advantageous properties that non-normal time series do not have. On the other hand, a prior information of non-normality is also beneficial since a heavy-tailed distribution modelling is often required in the analysis of financial time series. In this paper, we consider entropy-based tests for goodness of fit in time series models. Recently Lee et al. (2011) developed a maximum entropy test for iid r.v.s and demonstrated its useful applicability. Since this test outperform several existing gof tests, in this study, we particularly consider applying the maximum entropy test to time series models. We apply the maximum entropy test for fit to autoregressive time series models including non-stationary unstable. Its asymptotic distribution are derived under the null hypothesis. We perform a simulation study in order to explore the capabilities of the proposed test statistics. Particularly, a bootstrap method is employed to cope with small samples. We construct a real data analysis for illustration. And we also consider the maximum entropy test for models and generalized autoregressive conditional heteroscedastic(GARCH) model. In the derivation of the limiting null distribution of the test, the result of Escasiano(2010) turns out to be very useful, who studied the asymptotic behaviour of the residual empirical process in nonlinear GARCH models. Its asymptotic distribution is derived under the null hypothesis. A bootstrap version of the test is also discussed and its performance is evaluated through Monte Carlo simulations. A real data analysis is conducted for illustration.

Finite time ruin probability of the compound renewal model with constant interest rate and weakly negatively dependent claims

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Abstract

This paper established a simple asymptotic formula for the finite time ruin probability of a compound renewal risk model with constant interest force. We assume that the claim sizes are Weakly Negatively Dependent (WND) and identically distributed random variables belonging to the class of Regularly varying tails. The results obtained have extended and improved some corresponding results of related papers.

Modified Box-Cox transformation and manly transformation with failure time data

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Abstract

A family of transformations is an alternative method for analyzing data do not correspond with the assumption. There are many authors studied about it over a long time, e.g. Box and Cox (1964), Schlesselman (1971), Manly (1976). A well-known family of transformations often used in previous studies was proposed by Box and Cox. It appeared in Tan, Gan and Chang (2002), Gurka, Edwards and Nylander-French (2006), and so on. However, Box-Cox Transformation is not always applicable. John and Draper (1980) showed that the Box-Cox Transformation was not satisfactory even when the best value of transformation parameter had been chosen. Moreover, Doksum and Wong (1983) indicated that the Box-Cox transformation should be used with caution in some cases such as failure time and survival data. The simple case, some observations in the set of failure time data may be zero but the value of observation in the condition of Box-Cox transformation is greater than zero. In this case, Manly transformation may be appropriated than Box-Cox transformation because it was proposed as a family of exponential transformations that negative x values are also allowed. In this paper, Modified Box-Cox transformation copes with the problem as mentioned and Manly transformation were compared in the failure time data those have exponential and gamma distribution. They were investigated for some sets of the failure time data. It was found that Modified Box-Cox transformation and Manly transformation have not different efficiency in sense of normality and homogeneity of variances.

Asymptotic behavior of densities for stochastic functional differential equations

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Abstract

Consider stochastic functional differential equations depending on past histories of the segment in a finite time interval, whose coefficients are smooth and have bounded derivatives of all orders greater than 1 in the Frechét sense. The solution determines the non-Markovian process, so we cannot use any analytical methods. Under the uniformly elliptic condition on the coefficients of the diffusion terms of the equation, the probability law of the solution admits a smooth density with respect to the Lebesgue measure. In this talk, we shall focus on the study of the large deviations for the solution process, and apply it to the investigation on the asymptotic behaviors of the density, via the Malliavin calculus. The results obtained here are similar to the case of diffusion processes, and the effect of the time delay plays a crucial role.

Estimation of integrated covariances in the simultaneous presence of nonsynchronicity, noise and jumps

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Abstract

We propose a new estimator for the integrated covariance of two Ito semimartingales observed at a high-frequency. This new estimator, which we call the pre-averaged truncated Hayashi-Yoshida estimator, enables us to separate the sum of the co-jumps from the total quadratic covariation even in the case that the sampling schemes of two processes are nonsynchronous and the observation data is polluted by some noise. It is the first estimator which can simultaneously handle these three issues, which are fundamental to empirical studies of high-frequency financial data. We also show the asymptotic mixed normality of this estimator under some mild conditions allowing infinite activity jump processes with finite variations, some dependency between the sampling times and the observed processes as well as a kind of endogenous observation errors. We examine the finite sample performance of this estimator using a Monte Carlo study.

Smoothing of sign test and approximation of its p-value

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Abstract

In this talk we discuss theoretical properties of smoothed sign test, which based on a kernel estimator of the underlying distribution function of data. We show the smoothed sign test is equivalent to the usual sign test in the sense of Pitman efficiency, and its main term of the variance does not depend on the distribution of the population, under the null hypothesis. Though the smoothed sign test is not distribution-free, we can obtain Edgeworth expansion which does not depend on the distribution.

Let $X_1, X_2, \cdots, X_n$ be independently and identically distributed random variables with a distribution function $F(x-\theta)$, where the associated density function satisfies $f(x) = f(-x)$ and θ is a location parameter. Here we consider a null hypothesis $H_0 : \theta = 0$ against alternative $H_1 : \theta > 0$. Many nonparametric test statistics were proposed like, sign test, Wilcoxon's signed rank test etc. These tests are distribution-free and have discrete distributions. As pointed out by Lehmann (1975), because of the discreteness of the test statistics, p-value jumps in response to a small change in data values, when the sample size n is small or moderate. A smoothed version of rank methods is discussed by Brown et al. (2001). They have discussed a smoothed median estimator and a corresponding smoothed sign test. The smoothed sign test is not distribution-free, and so they have discussed an Edgeworth expansion. Their proposed smoothed sign test has good properties, but the Pitman's asymptotic relative efficiency ($A.R.E.$) does not coincides with the sign test. Here we will discuss the alternative smoothed sign test which is based on a kernel estimator of the distribution function, and show that its A.R.E. is same as the simple sign test.

New methods for statistical functionals – with applications to weakly dependent sequences and long-memory processes

Eric BEUTNER[1]

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Abstract

Using the notion of quasi-Hadamard differentiability that has been introduced by Beutner and Zähle we present two general results that can be used to obtain asymptotic properties for statistical functionals based on weakly dependent sequences and long-memory sequences. As examples we consider L- and U-statistics, in particular tail-dependent L-statistics as well as U-statistics with unbounded kernels. The results based on quasi-Hadamard differentiability provide especially new non-central limit theorems for L- and U-statistics of long-memory sequences. However, similar to previous approaches, the method of quasi-Hadamard differentiability does not allow for a general treatment of U-statistics based on long-memory sequences. To overcome the difficulties encountered by previous approaches, we derive a new representation for U-statistics. Using this representation the asymptotic distribution of U-statistics can be derived by a direct application of the Continuous Mapping Theorem. This approach yields a new and powerful tool to derive the asymptotic distribution of very general U-statistics based on long-memory sequences. This is exemplified by several astonishing examples. In particular, we present examples where weak convergence of U-statistics occurs at the rate a_n^3 and a_n^4, respectively, when a_n is the rate of weak convergence of the empirical process. We also introduce the notion of asymptotic (non-) degeneracy which often appears in the presence of long-memory sequences.

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Second-order least-squares estimation for regression models with autocorrelated errors: asymptotic properties and simulation results

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Abstract

In their recent paper, Wang and Leblanc (2008) have shown that the second-order least squares estimator (SLSE) is more efficient than the ordinary least squares estimator (OLSE) when the errors are iid (independent and identically distributed) with non zero third moments. In this paper, we generalize the theory of SLSE to regression models with autocorrelated errors. Under certain regularity conditions, we establish the consistency and asymptotic normality of the proposed estimator and provide a simulation study to compare its performance with the corresponding OLSE and GLSE (Generalized Least Square Estimator). It is shown that the SLSE performs well giving relatively small standard errors (se) and bias in estimating parameters of such regression models with autocorrelated errors. Based on our study, we conjecture that for less correlated data, the standard errors of SLSE lie between those of the OLSE and GLSE which can be interpreted as adding the second moment information can improve the performance of an estimator.

This is a joint work with Prof. Shelton Peiris from University of Sydney, Australia.

Central limit theorem and multiplier theorem when p is much larger than n

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Abstract

We derive a central limit theorem for the maximum of a sum of high dimensional random vectors. Specifically, we establish conditions under which the distribution of the maximum is approximated by that of the maximum of a sum of the Gaussian random vectors with the same covariance matrices as the original vectors. The key innovation of this result is that it applies even when the dimension of random vectors (p) is large compared to the sample size (n); in fact, p can be much larger than n. We also show that the distribution of the maximum of a sum of the random vectors with unknown covariance matrices can be consistently estimated by the distribution of the maximum of a sum of the conditional Gaussian random vectors obtained by multiplying the original vectors with i.i.d. Gaussian multipliers. This is the multiplier bootstrap procedure. Here too, p can be large or even much larger than n. These distributional approximations, either Gaussian or conditional Gaussian, yield a high-quality approximation to the distribution of the original maximum, often with approximation error decreasing polynomially in the sample size, and hence are of interest in many applications. We demonstrate how our central limit theorem and the multiplier bootstrap can be used for high dimensional estimation, multiple hypothesis testing, and adaptive specification testing. All these results contain non-asymptotic bounds on approximation errors.

Entropy-martingale methods in statistics

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Abstract

Starting from a stochastic maximal inequality, some entropy methods for separable random fields of locally square-integrable martingales will be presented, with the emphasis on the i.i.d. cases. A semi-parametric Z-estimation procedure will be discussed, with an illustrative application to Cox's regression model.

The convergence limit of the temporal difference learning

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Abstract

We consider a Markov process with a transition probability matrix and random rewards received after transition from some state to next state, and the goal is to estimate the value function, the expectation of the cumulative reward. In the temporal difference learning with a linear function approximation, the estimator converges some limit without the assumption that the value function is expressed as a linear combination of feature vectors, but not always the true value function. In this presentation, some properties of its limit are mentioned, and the algorithm is proposed in which the estimator converges the true value function adding a new feature vector.

On Lévy insurance risk models: A review and new directions

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Abstract

The field of risk theory has traditionally focused on ruin-related quantities. Expressions for the ruin problem now exist for a wide range of models, in particular for a general class of Levy insurance risk processes Although it is true that there are still many challenging questions, ruin related quantities do not seem to capture path-dependent properties of the reserve. In this talk we review existing models and results while emphasizing the role of the theory of fluctuations in understanding the ruin problem. A second objective of this talk is to discuss new directions of interest, in particular the study of non-ruin-related quantities. More precisely, we will discuss the probabilistic properties of drawdowns and the speed at which an insurance reserve depletes as a consequence of the risk exposure of the company. These new quantities are not ruin related yet they capture important features of an insurance position and we believe it can lead to the design of a meaningful risk measures. Studying drawdowns and speed of depletion for Levy insurance risk processes represent a novel and challenging concept in insurance mathematics. Indeed, drawdowns and speed of depletion are quantities that do not depend on the level but rather on path properties of the model which explain how fast the process can drop. This type of quantities has never been proposed before as measures of riskiness in insurance. Drawdowns have been only studied for diffusion processes in a finance setting [1], yet in insurance we need expressions for processes exhibiting jumps. Definitions of all these concepts are given as well as some examples of Lévy insurance risk processes for which they can be calculated. Future work and open questions are also discussed.

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Nonparametric estimate of the ruin probability in a pure-jump Lévy risk model

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Abstract

In this paper, we propose a nonparametric estimator of ruin probability in a Lévy risk model. The aggregate claims process $X = \{X_t, t \geq 0\}$ is modeled by a pure-jump Lévy process. Assume that high-frequency observed data on X is available. The estimator is constructed based on Pollaczeck-Khinchine formula and Fourier transform. Risk bounds as well as a data-driven model selection methodology are presented. Simulation studies are also given to show the finite sample performance of our estimator.

This is a joint work with Zhimin Zhang.

On a resampling scheme for empirical copulas

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Abstract

We investigate the asymptotic behavior of the resampling scheme for empirical copulas, proposed by Professor M. Sibuya.

Two independent sample test for folded normal data

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Abstract

The folded normal distribution is the distribution of the absolute value of a random variable for a given normally distributed random variable with mean μ and variance σ^2. Such a case may occur only the values are recorded regardless of their sign. Hence, probability measure of the normal distribution on $(-\infty, 0]$ is folded over to $[0, \infty)$. When $\mu = 0$, the folded normal random variable reduces to half normal random variable. The t-test comparing the equality of two population means assumes that the means of the different samples are normally distributed. This procedure, somewhat is not valid for folded normal data. In this study, for two-sample test, the pooled-variance and a test for equality of population means are derived for the random variables following the folded normal distribution. Then the asymptotic distribution of the test statistic is obtained for large sample size.

Performance of power divergence statistics under quasi independence model

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Abstract

In incomplete contingency tables, some category combinations may contain structurally zeros. The quasi-independence model, which is a generalization of the independence model, is most commonly used to analyze incomplete contingency tables. Goodness of fit tests of the quasi-independence model are usually based on Pearson chi square test statistic and likelihood ratio test statistic. In power divergence statistics family, the selection of power divergence parameter is of interest in multivariate discrete data. In this study, a simulation study is conducted to evaluate the performance of the power divergence statistics under quasi independence model for particular power divergence parameters in terms of power values.

Machine learning methods for conditional independence inference

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Abstract

Conditional independence is a fundamental concept in statistics and applied in a variety of fields. In order to analyze the properties of conditional independence, we deal with the implication problem of conditional independence statements, that is, testing whether a conditional independence statement is derived from a set of other conditional independence statements. To formulate the problem, let $N = \{1, \ldots, n\}$, and X_N be an n-dimensional random vector on a n-way contingency table. Then we consider to prove the following implication problem: $\{X_{A_i} \perp\!\!\!\perp X_{B_i} \mid X_{C_i}\}_{i=1}^{I} \Rightarrow X_A \perp\!\!\!\perp X_B \mid X_C$, where $A, B, C \subseteq N$ are disjoint and $A_i, B_i, C_i \subseteq N$ are disjoint in each i. To prove the above implication, we use the method of *imsets*. The method of imsets which is introduced by Studený(2005) provides a very powerful algebraic method for testing of conditional independence implications. By using imsets, the conditional independence implication problem is translated into relations among integer-valued vectors. However, it is known that there exist implications which are true but can not be proved by the existing methods of imsets. In order to partially overcome this difficulty, we propose a new machine learning method. The method is based on an idea that we can remove unnecessary information about conditional independence statements to prove the implication problem. We also discuss some computational results on our method.

Quantum hypothesis testing for Gaussian states

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Abstract

In recent years, movement for the achievement of the quantum information processing technology has been activated. Since it is necessary to prepare a quantum state and to manipulate it accurately for the quantum information processing, we need a proper method to decide whether the realized quantum state is the intended state. Thus, in such a situation, it is expected that the quantum hypothesis testing is required. In the classical hypothesis testing, testing problems for the Gaussian distribution frequently appear. When there is disturbance in the basic hypothesis testing problems for the Gaussian distributions, optimal tests are given by χ^2, t and F tests. These three kinds of testings are mostly applied in the classical hypothesis testing. But no quantum counterparts of χ^2, t and F tests have been studied. The importance of Gaussian distributions relies upon the central limit theorem. Similarly, due to the quantum central limit theorem, when many quantum states are independently and identically given, the quantum states are approximated by a quantum Gaussian state which frequently appears in quantum optical systems. In this presentation, we propose quantum counterparts of χ^2, t and F tests on testing problems for quantum Gaussian states. When there are nuisance parameters for a testing problem, we sometimes adopt the min-max criteria. That is, we optimize the worst value of the error probability concerning the nuisance parameters. In the min-max criteria, an optimal test can be obtained among the invariant test. This argument in a more general setting is justified by the quantum Hunt-Stein Theorem. However, there exists other type of difficulty except for nuisance parameters. Hence, combining the Hunt-Stein theorem with other reduction methods, we establish a general reduction theorem that reduces a complicated quantum hypothesis testing problem to a fundamental one.

Asymptotics of the Pitman random partition via combinatorics

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Abstract

The Pitman random partition is a two-parameter family of an exchangeable random partition of natural numbers, and has many statistical application such as in statistical disclosure control and Bayesian nonparametrics. The limiting distribution of the decreasing sequence of relative sizes of components is known to be the two-parameter Poisson-Dirichlet distribution, which is a random discrete distribution. The exact expressions of marginal distributions of the sequence of sizes in the Pitman random partition are obtained in terms of enumeration of partitions with size restrictions. They involve extensions of the generalized factorial coefficients and the signless Stirling numbers of first kind. Analytic combinatorics techniques give asymptotic properties of extreme sizes in the Pitman random partition, which attract interests in the relationship with number theory. We consider the case that the extreme sizes are $\asymp n$, where the limit is governed by the two-parameter Poisson-Dirichlet distribution, and the case that the extreme size is $o(n)$. It is shown that the asymptotic properties highly depend on one of the parameters of the Pitman random partition.

Goodness-of-fit statistics based on multifold integrated empirical distribution functions

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Abstract

Two classes of goodness-of-fit statistics based on multifold integrated empirical distribution functions are proposed. The proposed statistics are of integral forms whose integrand are standardized square of $(m-1)$-fold integrated empirical distribution functions. They are natural extensions of the goodness-of-fit statistic by Anderson and Darling (1952, AMS) and Watson (1961, Biometrika), which correspond to the case $m = 1$. The Karhunen-Loève expansions of the limiting integrand proceses as well as the limiting distributions of the goodness-of-fit statistics are obtained explicitly. The explicit forms of the Laplace transforms of the limiting distributions are also derived. Moreover, the relationship to boundary-value problems is pointed out. The Green functions of the corresponding boundary-value problems are derived.