International Conference on Applied Probability and Computational Methods in Applied Sciences

Organizing Committee
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Sponsor
Shanghai Center for Mathematical Sciences

Shanghai, China
November 2-3, 2015

SCHEDULE

Monday, Nov 2 — Room 2201, Guanghua East Building, Fudan University

Morning Session I

8:30	-	9:00	Peter Glynn, Stanford University, USA
9:05	-	9:35	Sandeep Juneja, Tata Institute of Fundamental Research, India
9:40	-	10:20	Coffee Break

Morning Session II

10:20	-	10:50	Jürg Hüsler, University of Bern, Switzerland
10:55	-	11:25	Gongjun Xu, University of Minnesota, USA

Lunch

Afternoon Session I

2:00	-	2:30	Richard Davis, Columbia University, USA
2:35	-	3:05	Thomas Mikosch, University of Copenhagen, Denmark
3:10	-	3:50	Coffee Break

Afternoon Session II

3:50	-	4:20	Henrik Hult, KTH Royal Institute of Technology, Sweden
4:25	-	4:55	Jinglai Li, Shanghai Jiaotong University, China

Dinner

Tuesday, Nov 3 — Room 2201, Guanghua East Building, Fudan University

Morning Session I

9:30	-	10:00	Yimin Xiao, Michigan State University, USA
10:05	-	10:35	Gennady Samorodnitsky, Cornell University, USA
10:40	-	11:00	Coffee Break

Morning Session II

11:00	-	11:30	Jingchen Liu, Columbia University, USA

Lunch

Abstracts

Richard Davis

On Central Limit Theorems for Weakly Dependent Random Fields with Applications

In this talk, I will describe central limit theorems for sums of observations from a kappa-weakly dependent random field. Specifically observations taken from a random field at irregularly spaced and possibly random locations in the domain of the random field are considered. The sums of these samples as well as sums of functions of pairs of the observations are often objects of interest for modeling spatial data. For example, if the underlying random field is strictly stationary, then one may be interested in estimated the mean and covariance functions by their sample counterparts. Central limit theorems for these quantities are established under quite general dependence conditions and various sampling scenarios for the locations of the observations. The illustration of these results for inference problems involving the stochastic heteroscedastic process (SHP) will be given. (This is joint work with Jingchen Liu and Xuan Yang.)

Peter Glynn

High Volume Traffic Modeling at Mesoscopic Time Scales

Many applications call for stochastic models that appropriately describe incoming traffic to a congested resource (e.g. popular websites, call centers, server farms, etc). In this talk, we discuss some of the limitations of conventional Poisson modeling, and point out what we call the Poisson breakdown phenomenon. In particular, real-world high volume traffic often exhibits medium time-scale (mesoscopic scale) correlations that are difficult to detect at the microscopic time scale of individual inter-arrivals. In view of this challenge, we discuss a class of Poisson autoregressive models intended to model traffic at such mesoscopic scales. These models are probabilistically very tractable and also lend themselves to straightforward calibration. (This work is joint with Xiaowei Zhang.)

Henrik Hult

Efficient importance sampling for computing credit value adjustment of interest rate portfolios

Prior to the financial crises in 2008, the credit risk in derivatives was not appropriately accounted for. Since then there has been an influx of value adjustments to derivative pricing collected under the name of XVA. The counterparty credit risk is this: A bank B trading derivatives with a counterparty C, is subject to the default risk of C. If C defaults at time T and the value of the derivative at that time is $V(T) > 0$ for the bank, then most likely B will not collect the full value of the derivative. The loss is called Lost Given Default

LGD. On the other hand if the value is negative then the defaulting C will terminate the contract and use the money in the default. Therefore, at default, there is a asymmetry in the value, and the loss is LGD $\times \max(V(T), 0)$.

The credit value adjustment (CVA) is the expected loss of the counterparty defaulting before maturity, taking into account netting effects. In this talk I will show how to construct efficient importance sampling algorithms for computing the CVA for a portfolio of interest rate derivatives, when the short-rate follows a simple one-factor Hull-White model.

Jürg Hüsler

Massive Excursions of Trajectories of Gaussian Fields

We consider the large excursion of a homogenous Gaussian random field $X(\mathbf{t})$, $\mathbf{t} \in \mathbb{R}^2$, with mean zero and unit variance, in a bounded set T. Of main interest are the excursions in two time points $\mathbf{t}, \mathbf{s}$ which are separated by a given $\varepsilon > 0$. The excursion depends on the correlation function $r(\mathbf{t})$. We describe the asymptotic probability of such excursions and the path behaviour between the two time points $\mathbf{t}, \mathbf{s}$ of exceedances. (This is joint work with Vladimir Piterbarg.)

Sandeep Juneja

Large deviations, selecting the best population and multi-armed bandit methods

Consider the problem of finding a population amongst many with the smallest mean when these means are unknown but population samples can be generated. Typically, by selecting a population with the smallest sample mean, it can be shown that the false selection probability decays at an exponential rate. Lately researchers have sought algorithms that guarantee that this probability is restricted to a small δ in order $\log(1/\delta)$ computational time by estimating the associated large deviations rate function via simulation. We show that such guarantees are misleading. Enroute, we identify the large deviations principle followed by the empirically estimated large deviations rate function that may also be of independent interest. Further, we show a negative result that when populations have unbounded support, any policy that asymptotically identifies the correct population with probability at least $1 - \delta$ for each problem instance requires more than $O(\log(1/\delta))$ samples in making such a determination in any problem instance. This suggests that some restrictions are essential on populations to devise $O(\log(1/\delta))$ algorithms with $1 - \delta$ correctness guarantees. We note that under restriction on population moments, such methods are easily designed. Further, under similar restrictions, sequential methods from multi-armed bandit literature can also be adapted to devise such algorithms.

Jinglai Li

Adaptive Independent Sampler MCMC for Infinite Dimensional Bayesian Inferences

Many scientific and engineering problems require to perform Bayesian inferences in function spaces, in which the unknowns are of infinite dimension. In such problems, many standard Markov Chain Monte Carlo (MCMC) algorithms become arbitrary slow under the mesh refinement, which is referred to as being dimension dependent. In this work we develop an independence sampler based MCMC method for the infinite dimensional Bayesian inferences. We represent the proposal distribution as a mixture of a finite number of specially parametrized Gaussian measures. We show that under the chosen parametrization, the resulting MCMC algorithm is dimension independent. We also design an efficient adaptive algorithm to adjust the parameter values of the mixtures from the previous samples. Finally we provide numerical examples to demonstrate the efficiency and robustness of the proposed method, even for problems with multimodal posterior distributions.

Jingchen Liu

On the Level Crossing of Likelihood Functions

Level crossing has been a classic topic. Most studies in the literature focus on Gaussian processes and more generally diffusion processes that often serve as the limiting objects of discrete processes. In this talk, we consider a generic parametric family of models and the level crossing of the likelihood function indexed by both the unknown parameter and the sample size. This study has implications on the asymptotic efficiency of several classic hypothesis testing procedures and the large deviations of the maximum likelihood estimator.

Thomas Mikosch

Nagaev-type large deviations for heavy-tailed processes

In a series of papers in the 1960s and 1970s, A.V. and S.V Nagaev proved precise large deviation results for sums of iid random variables with regularly varying tails. In 1995 the notion of a regularly varying stationary sequence was introduced in a paper by Richard A. Davis and Tailen Hsing (Ann. Probab.). This means that the finite-dimensional distributions of such a sequence have regularly tails. Examples are linear processes with with regularly varying noise variables, GARCH processes and affine stochastic recursions considered by Kesten (Acta Math., 1973). We present large deviation results for regularly varying stationary sequences and indicate how they can be applied to prove limit theory for sums, point processes and maxima. (This is joint work with Olivier Wintenberger.)

Gennady Samorodnitsky

Time-changed Extremal Process as a Random Sup Measure

A functional limit theorem for the partial maxima of a long memory stable sequence produces a limiting process that can be described as a beta-power time change in the classical Frechet extremal process, for beta in a subinterval of the unit interval. Any such power time change in the extremal process for $0 < \beta < 1$ produces a process with stationary max-increments. This deceptively simple time change hides the much more delicate structure of the resulting process as a self-affine random sup measure. We uncover this structure and show that in a certain range of the parameters this random measure arises as a limit of the partial maxima of the same long memory stable sequence, but in a different space. These results open a way to construct a whole new class of self-similar Frechet processes with stationary max-increments.

Yimin Xiao

Estimation of Fractal Indices for Bivariate Gaussian Random Fields

This talk is concerned with estimation of fractal indices of multivariate Gaussian random fields (or spatial processes). In the multivariate setting, it is important and challenging to quantify the effect of the cross dependence structure on the joint performance of the estimators. By extending the increment-based method (Chan and Wood, 2000, 2004; Anderes, 2010), we construct estimators for the fractal indices of a large class of locally stationary bivariate Gaussian random fields and investigated their joint statistical performance. We provide conditions on the cross covariance for the estimators to be asymptotically independent. The main results are applicable to the bivariate stationary Gaussian random fields with Matern cross covariance functions introduced by Kleiber, Gneiting and Schlather (JASA, 2010). (This talk is based on joint work with Yuzhen Zhou.)

Gongjun Xu

Rare-event Analysis for Extremal Eigenvalues of the Beta-Laguerre Ensemble

In this talk we consider the extreme behavior of the extremal eigenvalues coming from the beta-Laguerre ensemble, which is a generalization of the Wishart matrix and plays an important role in Multivariate Analysis. In particular, we focus on the case when the dimension of the feature p is much larger than or comparable to the number of observations n, a common situation in modern data analysis. We provide asymptotic approximations and bounds for the tail probabilities of the extremal eigenvalues. Moreover, we construct efficient Monte Carlo simulation algorithms to compute the tail probabilities. Simulation results show that our method has the best performance amongst known approximation approaches, and furthermore provides an efficient and accurate way for evaluating the tail probabilities in practice.
