



东北概率论及其应用研讨会

为了促进东北地区概率论及其应用的研究发展与交流，哈工大联合吉林大学、大连理工、东北师大、哈工程在哈工大数学研究院于 2023 年 7 月 20-22 日举办“东北概率论及其应用研讨会”。

时间：2023 年 7 月 20-22 日

地点：哈尔滨工业大学一校区明德楼 B201-1 报告厅

与会专家（以姓氏字母为序）

丛天枢 吉林大学

韩月才 吉林大学

靳水林 哈尔滨工业大学

李建阁 哈尔滨工业大学

刘全升 南布列塔尼大学

柳振鑫 大连理工大学

沈新美 大连理工大学

王 力 哈尔滨工业大学

王智拓 哈尔滨工业大学

魏晓利 哈尔滨工业大学

吴 昊 清华大学

吴黎明 哈尔滨工业大学

杨青山 东北师范大学

张朝恩 哈尔滨工业大学

张艳芬 哈尔滨工程大学

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会议日程

7月21日上午

主持人：吴黎明

08:50-09:00 开幕式，合影

09:00-10:00 刘全升

Large deviations and Gaussian approximation for products of random matrices

主持人：靳水林

10:20-11:05 韩月才

最优停时的深度学习算法及应用

11:10-11:55 杨青山

Large and moderate deviations of sample paths for non-homogeneous telegraph processes

7月21日下午

主持人：韩月才

14:00-15:00 柳振鑫

The averaging principle for SDEs with monotone coefficients

15:05-15:50 丛天枢

Convergence rate for geometric statistics of point processes with fast decay dependence

主持人：王 力

16:10-17:10 靳水林

An integration method for multiple heterogeneous single-cell RNA-seq data sets

17:15-18:00 张艳芬

A simple spectral test of adequacy check for weak VAR models





7月22日上午

主持人：柳振鑫

08:15-09:15 吴昊

Connection probabilities for Ising model and their relation to Dyson's circular ensemble

09:20-10:05 李建阁

The balls into bins problem and its variants

主持人：杨青山

10:25-11:10 沈新美

Uniform approximation for the tail behavior of bidimensional randomly weighted sums

11:15-12:00 张朝恩

Analysis of the entropy production phenomenon using functional inequalities

报告题目与摘要

7月21日上午

Large deviations and Gaussian approximation for products of random matrices

刘全升

南布列塔尼大学

Abstract: Some recent progress on limit theorems for products of independent and identically distributed random matrices will be presented. We focus on precise large deviations and convergence rates in the Gaussian approximation. Applications to branching processes and branching random walks will also be presented.





最优停时的深度学习算法及应用

韩月才

吉林大学

Abstract: 最优停时问题是一类重要的最优控制问题，其在衍生品定价和资产配置等金融领域有广泛应用。本报告讨论使用深度神经网络来求解复杂结构下高维最优停时问题和最优多停时问题，并探究了该方法的理论性质。结果表明：基于深度神经网络的方法可以高效准确地求解最优停时问题；理论结果证明，该方法在保证收敛性的同时具有较快的收敛速度；在一定的结构假设下，基于深度神经网络的方法可以克服求解高维问题时面临的维数灾难；通过状态空间划分对网络架构和训练集进行适当调整后，该方法在高维美式期权定价问题上表现出色。这些结果不仅说明了深度学习在解决最优停时问题时的有效性，还为深度学习在衍生品定价方面的应用提供了新的思路。

Large and moderate deviations of sample paths for non-homogeneous telegraph processes

杨青山

东北师范大学

Abstract: In this presentation, we focus on large and moderate deviations for the sample paths of non-homogeneous telegraph processes with singular intensity functions in the uniform topology. The conditions for these deviations are mainly based on the L^1 and L^2 norms of intensity functions. Specifically, we discuss a specific class of intensity functions that exhibit slow variation or periodicity. This work is conducted with Pro. Jiang Hui.





7月21日下午

The averaging principle for SDEs with monotone coefficients

柳振鑫

大连理工大学

Abstract: Averaging principle is an effective method for investigating multi-scale dynamical systems. In this talk, we will discuss three types of averaging principle for monotone stochastic differential equations, which includes monotone SPDEs, stochastic complex Ginzburg-Landau equations and finite dimensional monotone SDEs. Furthermore, we investigate the small fluctuations of the monotone SDEs around its average, and show that the normalized difference weakly converges to an Ornstein-Uhlenbeck type process, which can be viewed as a functional central limit theorem. This talk is based on joint works with Mengyu Cheng and Michael Röckner.

Convergence rate for geometric statistics of point processes with fast decay dependence

丛天枢

吉林大学

Abstract : [Błaszczyszyn, Yogeshwaran and Yukich (2019)] established central limit theorems for geometric statistics of point processes having fast decay of dependence. As limit theorems are of limited use unless we understand their errors involved in the approximation, we consider the rates of a normal approximation in terms of the Wasserstein distance for statistics of point processes on satisfying fast decay of dependence. We demonstrate the use of the theorems for statistics arising from two families of point processes: the rarified Gibbs point processes and the determinantal point processes with kernels decaying fast enough.





An integration method for multiple heterogeneous single-cell RNA-seq data sets

靳水林

哈尔滨工业大学

Abstract : An integrative study of multiple heterogeneous single-cell RNA sequencing (scRNA-seq) data sets is always needed in many biological and medical applications. Current methods cannot effectively integrate data sets from different biological conditions due to the confounding of biological and technical differences. We present scInt, an integration method with a unified contrastive biological variation learning framework. Using both simulated and real data sets, we show that scInt outperforms current methods, particularly when dealing with complex experimental designs. Several applications of scInt to real data analysis show the capability of integrating development trajectories and identifying functionally distinct condition-specific cell subpopulations.

A simple spectral test of adequacy check for weak VAR models

张艳芬

哈尔滨工程大学

Abstract: We propose a Cramér - von Mises(CM) statistics for the diagnostic check on weak VAR models, where the errors are assumed to be uncorrelated but not necessarily independent. The test statistics is constructed based on the distance between the sample periodogram of the residuals and a constant. Unlike portmanteau tests that use only the first m lags autocorrelations of the residuals, the spectral test can detect correlations beyond m lags. The asymptotic properties of the test statistics are studied. Since the dependent structure of errors and estimation uncertainty should be both taken into account, the test is not asymptotically pivotal. To cope with this, we employ a (blockwise) random weighting bootstrap method to approximate the critical values of the test and justify its first-order validity. The finite sample performance of the testing procedure is demonstrated through numerous Monte Carlo simulations and a real example analysis.





7月22日上午

Connection probabilities for Ising model and their relation to Dyson's circular ensemble

吴昊
清华大学

Abstract: Conformal invariance of critical lattice models in two-dimensional has been vigorously studied for decades. In this talk, we focus on connection probabilities for Ising model. This talk has two parts.

- In the first part, we consider critical Ising model and give the connection probabilities of multiple interfaces. Such probabilities are related to solutions to BPZ equations in conformal field theory.
- In the second part, we explain a relation between multiple Ising interfaces and Dyson's circular ensemble.

The balls into bins problem and its variants

李建阁

哈尔滨工业大学

Abstract: The balls into bins problem is a classical problem in probability theory that has many applications in computer science. It involves m balls and n bins. Each time, a ball is placed into a bin selected uniformly at random. We are interested in the following two-thinning variant. For each ball, after a random bin has been selected, we may choose to either accept it or place the ball into a new random bin. We are not aware of the secondary allocation before deciding whether to accept the primary allocation. We show explicit strategies that can achieve nearly optimal maximum loads. Comparisons are also drawn between this two-thinning variant and the well-known two-choice variant, in which case one selects two random bins and places a ball into the less loaded bin and ties are broken arbitrarily. (This talk is based on joint work with Ohad Noy, Feldheim and Ori Gurel-Gurevich.)





Uniform approximation for the tail behavior of bidimensional randomly weighted sums

沈新美

大连理工大学

Abstract : The uniform approximation for the tail behavior of bidimensional randomly weighted sums is considered. The primary random vectors are supposed to have extended regularly varying tails, while the underlying dependence between the components is described by some QERV copula functions. There are mild moment conditions on the random weight vectors without any assumptions on the dependence structures between themselves. The case when the number of the sums is extended to an integer-valued random variable is investigated additionally.

Analysis of the entropy production phenomenon using functional inequalities

张朝恩

哈尔滨工业大学

Abstract: The production of entropy is an essential feature of many important kinetic equations and stochastic processes in statistical physics. Functional inequalities comparing entropy with entropy production functional are basic to the study of entropy producing models, as they provide a powerful and robust tool to obtain quantitative rate of convergence to equilibrium. Such inequalities are usually referred to as entropy-entropy production inequalities (EEP inequalities in short). After a brief review of some classical results, I will present an EEP inequality for the McKean-Vlasov equation. Our result extends the one of Carrillo, McCann and Villani to a non-convex setting. And then I will also talk about some results on the EEP inequalities for the Landau equation. This talk is partly based on a joint work with Arnaud Guillin, Wei Liu and Liming Wu.

