第三届

山东大学-浙江大学

金融数学与概率极限理论研讨会

会

议

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2017 年 11 月 26 日 山东 济南

第三届山东大学-浙江大学金融数学与概率极限理论研讨会

会议通知

为了促进学术交流，加强学术合作，山东大学金融数学团队与浙江大学概率极限理论团队在山东大学中心校区举办研讨会，研讨会将围绕金融数学与概率极限理论的热点问题展开讨论，会议不收注册费，并承担与会人员的食宿费，往返交通费自理。

会议时间：2017 年 11 月 26 日
会议地址：山东省济南市山东大学中心校区知新楼 B1238

会议学术委员会：
彭实戈 院士　山东大学　林正炎 教授　浙江大学
陈增敬 教授　山东大学　张立新 教授　浙江大学
吴　臻 教授　山东大学　苏中根 教授　浙江大学

会议组织委员会：
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山东大学 中泰证券金融研究院

2017 年 10 月

日程安排

开幕式
8:30
彭实戈院士致辞，林正炎教授致辞，陈增敬教授致辞

Session 1

8:45-9:30
主持：彭实戈 院士
报告人：Sergei B. Kuksin 教授（巴黎第七大学）
报告题目：KAM and mixing

Session 2

9:30-10:15
主持: 林正炎 教授
报告人：彭实戈 院士（山东大学）
报告题目：Convergence rate of law of large numbers (LLN) and central limit theorem (CLT) with uncertainty of probabilities

10:15-10:30 **茶歇**

Session 3

10:30-11:15
主持: 林正炎教授
报告人：张立新 教授（浙江大学）
报告题目：Lindeberg's central limit theorems under sub-linear expectation

11:15-12:00
报告人: 苏中根 教授 (浙江大学)
报告题目：Wigner, Dyson and Semicircle Law

12:10 **午餐** **地点：学人大厦自助**

Session 4

14:00-14:45

主持：　　陈增敬教授

报告人：　　Peter Song 教授（密歇根大学）

报 告 题 目 ：　　Goodness-of-fit test in multivariate jump diffusion models with applications in financial time series

14:45-15:30

报告人：　　于志勇 教授（山东大学）

报告题目：　　Time-Inconsistent Recursive Stochastic Optimal Control Problems

15:30-15:45　　**茶歇**

Session 5

15:45-16:30

主持：　　苏中根教授

报告人：　　张朋 教授（浙江大学）

报告题目：　　Cluster analysis of categorical data with ultra-sparse features

16:30-17:15

报告人：　　胡明尚 副教授（山东大学）

报告题目：　　Stochastic maximum principle for optimization with recursive utilities under nonlinear expectation

17:30　　**晚宴**　　**地点：齐园**

会议报告摘要

KAM and mixing

Sergei B. Kuksin

I will explain how the KAM-theory provides a powerful tool to prove the mixing for dynamical systems of finite and infinite dimension, perturbed by a bounded random force which affects only a few degrees of freedom of the system.

Convergence rate of law of large numbers (LLN) and central limit theorem (CLT) with uncertainty of probabilities

Shige Peng

How to quantitatively measure the complicated and highly dy- namical risks in financial markets is a longtime challenging problem in theory and practice. The main problem is that although we has a huge and increasing size of financial data, but, it is, in principle, impossible to find or to approx- imate the 'true probability' hidden behind the data. Our LLN and CLT in nonlinear expectation theory provide powerful tools to robustly quantify finan- cial risks under the realistic assumption of the above uncertainty of probabilities and probability distributions. But in order to apply these theoretical result into practical quantitative finance, it is crucially important to obtain the convergence rates of these limit theorems.

In this paper, we present recent results on the convergence rate of LLN and CLT and explain how to apply them in practice with a new type of max- mean algorithm. Since the uncertainty of such type, often called Knightian uncertainty or ambiguitty are non-negligible in most practical cases, inside and outside of finance. This methodology and algorithm can be applied to a wide practical situation.

Lindeberg's central limit theorems under sub-linear expectations

Zhang Li-Xin

The Lindeberg's central limit theorem is the fundamental tool for studying the convergence of stochastic processes, especially stochastic integrals and differential equations. In this talk, we will present Lindeberg's central limit theorems and functional central limit theorems for independent but not necessarily identically distributed random variables as well as martingale like random variables under the sub-linear expectations. For establishing the results, Rosenthal's inequality and the exceptional inequality for the martingale like random variables are also given.

Wigner, Dyson and Semicircle Law

Zhonggen Su

随机矩阵的研究可追溯到 1920 年代，统计学家 Wishart(1929)计算出正态样本协方差矩阵的分布，许宝騄(1938-1939)给出多维 Hotelling 检验。但是，随机矩阵的真正发展始于 1950-60 年代，物理学家 Wigner 和数学家 Dyson 等人开展了一系列研究，从而开创了高维随机矩阵渐近分布理论。本报告主要介绍 Wigner 和 Dyson 所研究的矩阵模型：Bernoull 矩阵和 Gauss 矩阵，特别介绍特征根经验分布的极限分布---著名半圆律， 并引入两种经典方法：矩方法和正交多项式方法。

Goodness-of-fit test in multivariate jump diffusion models with applications in financial time series

Peter Song

We develop a new goodness-of-fit test to examine the specification of multivariate jump diffusion models. The test statistic is constructed by a kind of contrast between an "in-sample"likelihood (or a likelihood of observed data) and an "out-of-sample" likelihood (or a likelihood of predicted data). We show that under the null hypothesis of a jump diffusion process being correctly specified, the proposed test statistic converges in probability to a constant that equals to the number of model parameters in the null model. We also establish the asymptotic normality for the proposed test statistic.To implement this method, we invoke a closed-form approximation to transition density functions, which results in a computationally efficient algorithm to evaluate the test statistic. Using Monte Carlo simulation experiments, we illustrate that both exact and approximate versions of the proposed test perform satisfactorily. In addition, we applied the proposed testing method in the analysis of bivariate time series of weekly S&P 500 index and the implied volatility index during the period of January, 1990 and December, 2014. This is a joint with Drs. Shulin Zhang, Michelle Zhou and Dongming Zhu.

Time-Inconsistent Recursive Stochastic Optimal Control Problems

Zhiyong Yu

In this talk, a time-inconsistent stochastic optimal control problem with a recursive cost functional is studied. Equilibrium strategy is introduced, which is time-consistent and locally approximately optimal. By means of multi-person hierarchical differential games associated with partitions of the time interval, a family of approximate equilibrium strategy is constructed and by sending the mesh size of the time interval partition to zero, an equilibrium Hamilton-Jacobi-Bellman (HJB, for short) equation is derived through which the equilibrium value function can be identified and the equilibrium strategy can be obtained. Moreover, a well-posedness result of the equilibrium HJB equation is established under certain conditions, and a verification

theorem is proved. This talk is based a joint work with Dr. Qingmeng Wei and Prof. Jiongmin Yong.

Cluster analysis of categorical data with ultra-sparse features

Peng Zhang

We propose an unsupervised learning algorithm to cluster categorical data with ultra-sparse features. The proposed clustering method utilizes a new measure of similarity defined by a feature boosting strategy along with the latent representation of categorical variables. The proposed feature boosting method allows to explore effectively the underlying patterns of categorical data, and amplify cluster structures to enhance data separation and interpretation of relationships among data points. Another model based approach to clustering sparse binary data is named Hierarchical Bayesian Bernoulli mixture model (HBBMM), which incorporates a constrained empirical Bayes prior for model parameters so that searching and updating of estimators are confined in a proper region. An expectation maximization (EM) algorithm is utilized to estimate the maximum a posterior (MAP). Three criteria are presented to identify defining features in each cluster, in helping to detect the underlying structure of the sparse data. Simulation studies are conducted to evaluate the performance of these proposed clustering algorithms in the presence of sparse attributes. Two real datasets, single-cell scRNA-seq expressions and descriptors of business classes, are analyzed to illustrate the proposed methodology with comparisons to some of the existing algorithms.

Stochastic maximum principle for optimization with recursive utilities under nonlinear expectation

Mingshang Hu

We study two kind of stochastic recursive optimal control problems. The cost function in the first kind is defined by the solution of BSDE, and we obtain the maximum principle which solves completely Peng's open problem. The cost function in the second kind is defined by the solution of G-BSDE, and we obtain the maximum principle by the linearization and weak convergence methods.