Fall 2015

Friday November 20, 2015
Dr. Wei Wu
Assistant Professor, Department of Psychology
the University of Kansas

A Comparison of Imputation Strategies for Ordinal Missing Data on Likert Scale Variables

ABSTRACT

This pretention compares a variety of imputation strategies for ordinal missing data on Likert scale variables (number of categories = 2, 3, 5, or 7) in recovering reliability coefficients, mean scale scores, and regression coefficients of predicting one scale score from another. The examined strategies include imputing using normal data models with naïve rounding/without rounding, using latent variable models, and using categorical data models such as discriminant analysis and binary logistic regression (for dichotomous data only), multinomial and proportional odds logistic regression (for polytomous data only). The result suggests that both the normal model approach without rounding and the latent variable model approach perform well for either dichotomous or polytomous data regardless of sample size, missing data proportion, and asymmetry of item distributions.

Friday November 13, 2015
Dr. Yasuyuki Kachi
Associate Professor, Department of Mathematics
the University of Kansas

Primes, Zeta and Asymptotic formulas - Granville-Zagier's multi-zeta values

ABSTRACT

The mystery of prime numbers prompts one to study Riemann's zeta function ("zeta"). I first motivate the audience why we study zeta, explain the "Euler product", and then spotlight the multi-faceted personality of zeta: (1) Bernoulli numbers/polynomials. Akiyama-Tanigawa algorithm. (2) A new interpretation of the celebrated Granville-Zagier's theorem on multi-zeta values. (3) A new framework which includes Stirling's formula as an archetype (asymptotic formula). Vexing phenomenon concerning `renormalization' of the infinite product (x+1) (x+2) (x+3) ... that has eluded investigation. (4) Functional Identity. Open problem: Does zeta have a "significant other" (does it have an Euler product)? The content of the talk reflects my joint work with P. Tzermias and C. Fang. The talk will be completely accessible to students with basic calculus and linear algebra background.

Friday November 6, 2015
Dr. Hongyan Hou
Ph.D., Department of Mathematics
the University of Florida

Convergence Rate for Gauss and Radau Collocation Method Applied to Unconstrained Optimal Control

ABSTRACT

The local convergence rates are established for the orthogonal collocation methods based on the Gauss quadrature or the Radau quadrature applied to an unconstrained optimal control problem. For the orthogonal collocation method based on Gauss quadrature, neither end point of the problem domain is a collocation point. For the Radau quadrature scheme, one end point is a collocation point. If the continuous problem has a sufficiently smooth solution and the Hamiltonian satisfies a strong convexity condition, then the discrete problem possesses a local minimizer in a neighborhood of the continuous solution, and as the number of collocation points increases, the discrete solution convergences exponentially fast in the sup-norm to the continuous solution.

Friday October 30, 2015
Dr. Devin Koestler
Assistant Professor, Department of Biostatistics
the University of Kansas Medical Center

An Algorithm for Estimating the Cellular Composition of Blood using DNA Methylation Biomarkers: The Rich Get Richer and the Poor Get Poorer

ABSTRACT

The past decade has witnessed an explosion of studies aimed at understanding the role of DNA methylation (DNAm) in states of human health and disease, as well as its susceptibility to modification based on environmental exposures. Like gene expression (GE) array data, such studies often involve the comparison DNAm signatures between a sample of diseased and non-diseased subjects with the goal that knowledge gained from such comparisons will lead to an improved understanding of the mechanisms underlying pathogenesis, provide insight on new therapeutic targets, and/or reveal novel biomarkers for diagnosis/prognosis. In this talk, I will discuss ongoing work that involves the development of a statistical methodology for estimating the cell composition of blood; a heterogeneous tissue-type that is frequently used for assessing DNAm. Our approach is similar to regression calibration and involves projecting the DNAm signature blood sample onto a reference data set, which consists of the DNAm signatures across a spectrum isolated white blood cell types.

Friday October 23, 2015
Dr. Xuemin Tu
Associate Professor, Department of Mathematics
the University of Kansas

Parameter Estimate for an Elliptic Problem using Implicit Sampling

ABSTRACT

There are increasing interest in uncertainty quantification for differential equations with uncertain input data. These data can be the initial conditions, boundary conditions, or the parameters in the differential equations. In this talk, we focus on the uncertainty quantification of an elliptic inverse problem, where the uncertain data is the diffusion coefficient. The implicit sampling method is used to sample the posterior density, which combines the prior information about the parameter with the noisy data. The results of our computations are the parameters

that are compatible with the data.

Friday October 16, 2015
Dr. Shuanglin Shao
Assistant Professor, Department of Mathematics
the University of Kansas

On the Pointwise Convergence Problem of the Schrödinger Operator

ABSTRACT

The free Schrödinger equation is
i ∂u/∂t+Δu=0, u(0,x)=f(x).
The solution u can be expressed in terms of the initial data by using the Fourier transform. Carleson raised the question for what initial data its free Schrödinger solution converges to the initial data in the pointwise sense when time goes to zero. I will present the background and recent progress of this problem.

Friday October 9, 2015
Dr. Jessica Conway
Assistant Professor, Department of Mathematics
Penn State University

ART-mediated HIV Viral Dynamic

ABSTRACT

Antiretroviral therapy (ART) effectively controls HIV infection, suppressing HIV viral loads. We will discuss models predicting HIV viral dynamics in the presence of ART, and following the suspension of ART. Although ART is very effective, some residual virus remains in HIV-infected patients on ART, albeit below the level of detection of routine tests. The source of this viremia is an area of debate: does it derive from ongoing rounds of viral replication, activation of infected cells in the latent reservoir, or some combination of the two? Observations seem to be contradictory. Rarity of emergent drug resistance, resulting from mutation during viral replication, implies that viremia derives HIV archived in the latent reservoir, but evidence of short-term evolution remains, implying ongoing viral replication. We will discuss a simple deterministic model with its stochastic analogue, showing that the model recapitulates features of treated infection and reconciles the apparently opposing observations. Suspension of ART for HIV typically leads to rapid viral load rebound to pre-treatment levels. However, reports suggest that early ART initiation may delay viral rebound, for months, years, or permanently (post-treatment control, PTC), after ART suspension. We will also discuss a model of post-treatment HIV dynamics. From a branching process formulation we derive viral rebound time probability densities and the probability of PTC. Using these, we discuss viral rebound times and conditions for PTC.

Friday September 22, 2015
Dr. Jiu Ding

Professor, Department of Mathematics
The University of Southern Mississippi

Recent Developments on Solving the Yang-Baxter Matrix Equation

ABSTRACT

We introduce basic techniques in solving the quadratic matrix equation
AXA=XAX
, and we present some recent results on finding all the commuting solutions if A is diagonalizable and all the solutions if A is of some special structure.

Spring 2015

Friday April 10, 2015
Dr. Xinghe Wang
Professor, Department of Economics
The University of Missouri—Columbia

A Model of Partial Sequential Search

ABSTRACT

In many familiar shopping situations, it is often up to the consumers to decide how many attributes to evaluate among the products they consider. However, many conventional search models assume that search is a discrete process in which consumers either acquire all relevant information of a product or acquire no information. This paper relaxes this conventional assumption by allowing the possibility of partial product evaluation and provides a boundary of the conventional search models. We explore partial product evaluation in a sequential search model and our results show that consumers optimally choose to evaluate products at partial depth when search costs are sufficiently large. In addition, due to partial product evaluation, firms' prices and search costs have a non-monotonic relationship. Our findings also show a non-monotonic relationship between consumer surplus and search costs.

Friday April 3, 2015
Dr. Xianyang Zhang
Assistant Professor, Department of Statistics
The University of Missouri—Columbia

White Noise Testing and Model Diagnostic Checking for Functional Time Series

ABSTRACT

In this talk, we consider white noise testing and model diagnostic checking for stationary functional time series. To test for the functional white noise null hypothesis, we propose a Cramer-von Mises type test based on the functional periodogram introduced by Panaretos and Tavakolithe (2013). Using the Hilbert space approach, we derive the asymptotic distribution of the test statistic under suitable assumptions. A new block bootstrap procedure is introduced to obtain the critical values from the non-pivotal limiting

distribution. Compared to existing methods, our approach is robust to the dependence within white noise and it does not involve the choices of functional principal components and lag truncation number. We employ the proposed method to check the adequacy of functional linear models and functional autoregressive models of order one by testing the uncorrelatedness of the residuals. Monte Carlo simulations are provided to demonstrate the empirical advantages of the proposed method over existing alternatives. Our method is illustrated via an application to cumulative intradaily returns.

Friday, March 20, 2015
Dr. Paul Rulis
Assistant Professor, Department of Physics
The University of Missouri—Kansas City

Can Artificial Neural Networks Be Used to Supplant Self-Consistent Field Calculations within Density Functional Theory?

ABSTRACT

Ab initio electronic structure calculations based on quantum mechanics have become essential tools for materials scientists that need to access wave function-based material properties. Although advanced methods and advanced computers have increased the size of the material systems that can be studied with these methods, it has proved difficult to scale beyond a few thousand atoms. This is a point of frustration because many of the more interesting material systems at the nano-scale require on the order of ten to twenty thousand atoms to model. Similarly, if a problem requires the use of *ab initio* molecular dynamics it will be severely restricted in its duration because of the computational cost. In this presentation we explore an alternative method for calculating accurate total energies of complex defect containing solids that is based on machine learning instead of traditional self-consistent field (SCF) calculations. Progress of the method as applied to a passive defect model in silicon, a self-interstitial model in silicon, and a model of amorphous silica will be presented.

Friday, March 13
Dr. Yumou Qiu
Assistant Professor, Department of Statistics
The University of Nebraska—Lincoln

Thresholding Tests for Signal Detection on High-Dimensional Count Distributions

ABSTRACT

Motivated by the analysis of RNA sequencing (RNA-seq) data for genes differentially expressed across multiple conditions, we consider detecting rare and faint linear combinations of the regression coefficients (which we call signals) in high-dimensional response variables which are usually count data. More generally, we address the signal detection problem under generalized linear models. We propose a test statistic that carries out a multi-level thresholding on maximum likelihood estimators (MLEs) of the signals, which allows removal of the dimensions with no signals. A Cramer type moderate deviation result for multi-dimensional MLEs is derived, which is needed to obtain the asymptotic distribution of the thresholding test statistic. Extensions to generalized linear mixed models are made, where Gauss-Hermite quadrature is used to

approximate the MLEs of such models. Numerical simulations and a case study on maize RNA-seq data are conducted to confirm and demonstrate the proposed testing approaches.

Friday, February 27, 2015
Dr. Yong Zeng
Professor and Chair, Department of Mathematics and Statistics
The University of Missouri—Kansas City

Bayesian Inference via Filtering Equations for Financial Ultra-High Frequency Data

ABSTRACT

We propose a general partially-observed framework of Markov processes with marked point process observations for ultra-high frequency (UHF) transaction price data, allowing other observable economic or market factors. We develop the corresponding Bayesian inference via filtering equations to quantify parameter and model uncertainty. Specifically, we derive filtering equations to characterize the evolution of the statistical foundation such as likelihoods, posteriors, Bayes factors and posterior model probabilities. Given the computational challenge, we provide a convergence theorem, enabling us to employ the Markov chain approximation method to construct consistent, easily-parallelizable, recursive algorithms. The algorithms calculate the fundamental statistical characteristics and are capable of implementing the Bayesian inference in real-time for streaming UHF data, via parallel computing for sophisticated models. The general theory is illustrated by specific models built for U.S. Treasury Notes transactions data from GovPX and by Heston stochastic volatility model for stock transactions data. This talk consists joint works with B. Bundick, X. Hu, D. Kuipers and J. Yin.

Friday, February 13, 2015
Dr. Weishi Liu
Professor, Department of Mathematics
University of Kansas

Analysis of Poisson-Nernst-Planck Systems and Applications to Ion Channel Problems

ABSTRACT

In this talk, I will start with a brief background of ion channel problems and some central topics of biological interests. Poisson-Nernst-Planck (PNP) type systems, a class of primitive models for ionic flows, will then be described. A dynamical system framework for analyzing PNP will be reviewed. As an illustration, a number of concrete applications to ion channel problems will be discussed.