Statistical Sciences
UNIVERSITY OF TORONTO

Graduate Student Seminars

Thursday March 20th, 2014 at 3:30pm

Sidney Smith Hall, Room 1074

Refreshments will be served at 3:15pm

Structural Change Detection For Regression Quantile with Non-stationary Errors

Weichi Wu

We consider quantile structural change detection for linear modesl with random design and a wide class of non-stationary errors. New uniform Bahadur representations are established with almost the best approximation rate except a factor of logarithm. Two test statistics, one based on regression coefficients and the other based on residuals are proposed. Their asymptotic behavior theories are developed. Boots trap methods are provided to calculate critical values. Monte Carlo experiments are carried out to investigate their finite sample performance and to compare our testing procedure with several existing tests of change point in the literature of quantile regression. Our methodology is applied to USA Real GDP series, and asymmetry of structural change in different quantiles are found.

MCMC methods for Bayesian Logistic Regression on Breast Cancer Data

Reihaneh Entezari

Logistic regression of high-dimensional data presents many computational and statistical challenges. We describe a Bayesian logistic regression approach on the "Wisconsin Diagnostic Breast Cancer Data", where we will implement various different Markov Chain Monte Carlo (MCMC) methods to sample from its posterior distribution. We will apply and compare MCMC methods such as Metropolis algorithm, Metropolis-within-Gibbs (with two different scaling procedures), and Gibbs sampling using Polya-Gamma latent variables. Furthermore, we will compare the results to the Variational Approximation algorithm (which approximates the posterior), and conclude that the Gibbs sampling using Polya-Gamma latent variables has the best performance among all the other algorithms.

Nonstandard analysis and its application to Markov process

Haosui Duanmu

The method of nonstandard analysis was introduced by Robinson from last century. It has been widely used in various field of mathematics including analysis, topology, probability theory, etc. In my presentation, I will start with a gentle introduction of nonstandard analysis. I will give a brief idea of the construction of the nonstandard extension and introduce the concept of internal set, transfer principle, saturation principle in the nonstandard extension of R (denoted by *R). I will then introduce the construction of Loeb probability space. It is a standard probability space but constructed from a nonstandard prospective. The Loeb probability space is extremely useful in the study of nonstandard stochastic processes and it has close connection to the usual Lebesgue measure. Finally, I will talk about my project which is using nonstandard method to prove the convergence of continuous time Markov process. The classic proof is to use the idea of embedded chain. We let the time line be $\{0, \delta t, \ldots, K\}$ where δt is some infinitesimal and K is a hyperfinite number. Such characterization in one hand will make the continuous time Markov chain behaves much like the discrete time chain. On the other hand, the hyperfinite time line contains all the rational time points and would have the key properties of the standard continuous time Markov chain. The proof of the hyperfinite Markov chain converges to its stationary distribution would lead to the proof of the convergence of the standard chain.

Pricing and Hedging of Variable Annuities on Mixed Fund under Levy Processes

Yuxiang Chong

We analyze variable annuities which are backed by mixed fund built out of stock and bond indices. The stock index and bond index are modeled as exponential Levy processes. The interest rate is modeled as mean-reverting process. We develop a pricing methodology for a guaranteed rate of return via using Fourier transform methods. Next we investigate the sensitivities of management fees w.r.t different model parameters. Jump risk leads to incomplete market where complete hedging does not exist. We deal with hedging this product using local risk minimization techniques. Finally we investigate the pricing and hedging of different types of unit-linked insurance products after incorporating mortality risk. Numerical examples comparing different hedging strategies are also provided.

Regularized Partially Functional Linear Model

Kaijie Xue

In modern scientific experiments we often face analysis with functional data, where the observations are sampled from random processes, together with a potentially large number of non-functional covariates. The complex nature of functional data makes it difficult to directly apply existing methods to model selection and estimation. We propose and study a new class of partially functional linear models to characterize the regression between a scalar response and multiple covariates, including both functional and scalar types. This method provides a unified and flexible framework to jointly model functional and non-functional predictors, identify important covariates, and improve efficiency and interpretability of the estimates. Featured with two types of regularization: the shrinkage on the effects of function- al and scalar covariates and the truncation on principal components of the functional predictor, the new approach treats functional predictors from a nonparametric perspective and focuses on inferring both the structure of functional predictors and scalar covariates. The underlying processes of the functional predictors are considered genuinely infinite-dimensional, and a key contribution is to associate the impact of truncation explicitly with the asymptotic behavior. We then establish consistency and oracle properties under mild conditions by allowing possibly ultrahigh dimensional scalar covariates and simultaneously taking the functional predictor into account. We illustrate the performance of the proposed method with simulation study.

Power loss caused by using non-optimal weights in meta-analysis

Bo Chen

Meta-analysis refers to methods that focus on combining results from different studies to improve the precision of estimates. When the same hypothesis is tested by different studies, the most common method is to combine weighted Z-scores of each study, where the weights are proportional to square root of sample size. However, these weights are not optimal, and the optimal weights should be decided by standard error of each estimates rather than the sample size. Theoretical power loss of the test based on combined test statistic is studied by comparing the optimal and non-optimal weights in various situations, and worst case scenarios are of particular interest where maximum power loss is achieved. I find the maximum power loss cannot be neglected and optimal weights should be preferred in most meta-analysis studies.