Location: Haag Hall, room 309 (Unless otherwise noted)
Day & Time: Fridays, 3:00-3:50 pm (Unless otherwise noted)
Campus Map for Talks (PDF Format)

Organizer: Dr. Yong Zeng, 235-2850
Email: zengy@umkc.edu

Dates, Titles, Speakers (with Abstracts as available)

- **Friday, Mar. 2**
  Dynamical Geometry — From Order to Chaos
  Jiu Ding, Department of Mathematics, University of Southern Mississippi

  We take a sightseeing on a way from order to chaos in the garden of dynamical geometry. We also present some results about Sierpinski pedal triangles, a class of new fractals constructed by X. M. Zhang which generalize the classic Sierpinski triangle. This talk can be understood by undergraduate mathematics major students.

- **Friday, Mar. 16**
  Subprime Mortgage Crisis Credit Supply Evidence
  Mansour Haroun, BB&T Corporation

  We use the subprime crisis to show how leverage can easily be compounded at various levels and for numerous market participants, by analyzing the factors which led to the crisis. We review the impact of underwriting standards and the availability of funds through the securitized market. We review the empirical findings and the statistical approaches used as well as the economic literature on bubble formation and propose further avenues for statistical testing. Empirical and theoretical work indicates the importance of controlling leverage on an ongoing basis to avoid bubble formation.

- **Thursday, Apr. 5**
  Time: 2:00-3:00pm Room: Flarsheim Hall 310
  (Joint arrangement with University of Missouri Dept of Statistics)
  Modeling and Analyzing High-Frequency Financial Data
  Yazhen Wang, Department of Statistics, University of Wisconsin—Madison

  Volatilities of asset returns are central to the theory and practice of asset pricing, portfolio allocation, and risk management. In financial economics, there is extensive research on modeling and forecasting volatility up to the daily level based on Black-Scholes, diffusion, GARCH, stochastic volatility models and implied volatilities from option prices.

Nowadays, thanks to technological innovations, high-frequency financial data are available for a host of different financial instruments on markets of all locations and at scales like individual bids to buy and sell, and the full distribution of such bids. The availability of high-frequency data stimulates an upsurge interest in statistical research on better estimation of volatility. This talk will start with a review on low-frequency financial time series and high-frequency financial data. Then I will introduce popular realized volatility computed from high-frequency financial data and present my work on large volatility matrix estimation.

- **Friday, Apr. 13 — Weller Overstreet Lectures in Science**
  Cancelled.
  Refreshments before the talk — See poster.
  Identifying Separated Time-scales in Stochastic Models of Cellular Reaction Networks
  Tom Kurtz, Department of Mathematics / Department of Statistics, University of Wisconsin—Madison

  Continuous time Markov chains have become a standard way of modeling chemical reaction networks in biological cells. The talk will begin with a review of some of the basic approaches for specifying and analyzing these models. In these models, reaction rates and chemical species numbers may vary over several orders of magnitude. Combined, these large variations can lead to subnetworks operating on very different time-scales. This separation of time-scales has been exploited in many contexts as a basis for reducing the complexity of dynamic models, but the interaction of the rate constants and the species numbers makes identifying the appropriate time-scales tricky at best. Some systematic approaches to this identification will be discussed and illustrated by application to one or more reaction network models.

- **Thursday, Apr. 19**
  Time: 2:00-3:00pm Room: Royall Hall 215
  Modeling Daily Rainfall and Detecting Changepoints
  Veena Vezhapparambu, UMKC Department of Mathematics & Statistics, MS Student

  We introduce stochastic modeling for daily rainfall time series data. Rainfall amounts for Kansas City are explored in the 1920s and 1930s. The first order Markov Chain model is described and shown to be an effective model in capturing the correlation in the data. Lastly, the different techniques are utilized in testing for changepoints in the series. The data indicates a change may occur shortly after the stock market crash of 1929.

- **Friday, Apr. 20**
  (Joint arrangement with KU Dept of Mathematics)
  Econometrics of High Frequency Data: Background and New Developments
  Per Mykland, Department of Statistics, University of Chicago

Recent years have seen a rapid growth in high frequency financial data. This has opened the possibility of accurately determining volatility in small time periods, such as one day, or even less. We introduce the types of data, and discuss what quantities can reasonably be estimated in this setting, such as skewedness, and high frequency regression parameters. The talk provides background for this kind of high frequency inference, and then discusses challenges and recent innovations in the area. The talk is particularly focused on issues involving endogenous times, market microstructure, and local likelihood.

Location: Haag Hall, room 307 (Unless otherwise noted)
Day & Time: Fridays, 3:00-4:00 pm (Unless otherwise noted)
Campus Map for Talks (PDF Format)

Organizer: Dr. Majid Bani-Yaghoub, 235-2845
Email: baniyaghoubm@umkc.edu

- **Previous Semester** Schedule of the Graduate Seminar Series

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Dates, Titles, Speakers (with Abstracts as available)

Fall 2012

- **Friday, Sep. 7**
  Mechanisms of actomyosin ring contraction for budding yeast cell division
  Boris Rubinstein, Stowers Institute for Medical Research

  Actin filaments and myosin-II are evolutionarily conserved force generating components of the contractile ring during cytokinesis. We show that in budding yeast actin filament depolymerization plays a major role in actomyosin ring constriction. Cofilin mutation or chemically stabilizing actin filaments attenuates actomyosin ring constriction. Deletion of myosin II motor domain or the myosin regulatory light chain reduced the contraction rate and also the rate of actin depolymerization in the ring. We constructed a quantitative microscopic model of actomyosin ring constriction via filament sliding driven by both actin depolymerization and myosin II motor activity. Model simulations based on experimental measurements supports the notion that actin depolymerization is the predominant mechanism for ring constriction. The model predicts invariability of total contraction time irrespective of the initial ring size as originally reported for *C elegans* embryonic cells. This prediction was validated in yeast cells of different sizes due to having different ploidies.

- **Friday, Sep. 14**
  Challenges in computation of basic and type- reproduction numbers for disease models with free-living pathogen
  Majid Bani-Yaghoub, UMKC Department of Mathematics and Statistics

  The basic reproduction number R_0 is a threshold quantity that is used to measure the intensity of disease spread in a community. The Next Generation Matrix (NGM) approach is often used to calculate a unique R_0 expression. This study shows that the uniqueness of R_0 expression is lost when a disease model includes growth and survival of free-living pathogen. Consequently, the R_0 values related to an infection can be substantially different. The issue of multiple R_0 Expressions is partly resolved when the type reproduction number T is used. However, the T expression related to the infected host population is meaningful only when the net growth rate of free-living pathogen is negative. These results are shown by considering a susceptible-infected-recovered-susceptible model with free-living pathogen. Furthermore, the conditions for global stability of the endemic and disease-free equilibria are established via LaSalle's invariance principle and the method of Lyapunov function.

- **Friday, Sep. 21**
  Statistical Methods for Tissue Images: Algorithmic Scoring, Data Contamination, and Blessings of Dimensionality
  Donghui Yan, UMKC Department of Mathematics and Statistics

  Tissue microarray (TMA) technology allows one to evaluate large numbers of immunohistochemically-stained tissue images and has been successfully used in many applications, such as clinical outcome analysis, tumor progression analysis, identification of risk factors, validation of biomarkers etc. In response to concerns about the subjectivity and variability of pathologist-based TMA evaluation, we develop the TACOMA algorithm to automatically score TMAs in an efficient and objective manner. The statistical regularity in TMAs are effectively captured by statistics related to the transition of gray levels. A few "representative" image patches allow TACOMA to focus on biologically relevant features and score in a similar way as the pathologists. Experiments with TMA images for different biomarkers show that TACOMA rivals pathologists in terms of accuracy and reproducibility. Moreover, it is able to reveal salient pixels in an image most relevant to scoring. There are two particular challenges in the training of TACOMA, label noise (scores by pathologists often different from the "truth") and the small training sample size. Co-training allows us to substantially boost performance for a small training sample. Theoretical insights are given to the success of thinning-based co-training, which is particularly relevant to high-dimensional settings with "sufficient" redundancy among features. Time permitting, I will discuss a recent work on data contamination, motivated by the image mis-registration problem and the observed label noise during TMA image scoring. In particular, the impact of data contamination to classification will be discussed, for which a sharp asymptotic data contamination bound is established.

- **Friday, Oct. 5**
  The Hot Spots Conjecture and its Discrete Analogue
  Chris Evans, Department of Mathematics, U of MO

  The hot-spots conjecture was proposed by Jeffery Rauch in 1974 and roughly conjectures the following: Consider a 2-dimensional connected insulated piece of metal. If the metal is given an initial heat distribution and the heat is then allowed to flow, eventually the hottest and coldest points will lie on the boundary. Mathematically, the conjecture concerns the second eigenfunction of the Neumann-Laplacian on a connected 2-dimensional domain D. Since its statement, the hot-spots conjecture has been proven for some domains and counter-examples have been exhibited for others. In particular, while the conjecture is known to be true for obtuse triangles, the conjecture has not yet been proven for general triangles!

I will give an overview of what is known about the hot-spots conjecture and show how coupled reflected Brownian motion can be used to give an elegant proof in some domains. I will then also discuss the discrete analogue of the conjecture and explain a result of mine where I exhibit a counter example to a related conjecture of Moo Chung in the discrete case.

- **Friday, Oct. 12**
  On Personalized Information Filtering
  Xiaotong Shen, University of Minnesota

  Personalized information filtering extracts the information specifically relevant to a user, based on the opinions of users who think alike or the content of the items that a specific user prefers. In this presentation, I will introduce partial latent models to utilize additional user-specific and content-specific predictors, for personalized prediction. In particular, we factorize a user-over-item preference matrix into a product of two matrices, each representing a user's preference and item preference by users. On this basis, we seek a sparsest latent factorization from a class of overcomplete factorizations, possibly with a high percentage of missing values. A likelihood approach will be discussed, with an emphasis on scalable computation. Examples will be given to contrast with popular methods for collaborative filtering and contented-based filtering.

- **Friday, Oct. 19**
  Spatial Spread and Front Propagation Dynamics of Nonlocal Monostable Equations in Periodic Habitats
  Aijun Zhang, Department of Mathematics, The University of Kansas.

  This talk is concerned with the spatial spread and front propagation dynamics of monostable equations with nonlocal dispersal in spatially periodic habitats. Such equations arise in modeling the population dynamics of many species which exhibit nonlocal internal interactions and live in spatially periodic habitats. Firstly, we establish a general principal eigenvalue theory for spatially periodic nonlocal dispersal operators. Secondly, applying such theory and comparison principle for sub- and super-solutions, we obtain the existence, uniqueness, and global stability of

spatially periodic positive stationary solutions and the existence of a spatial spreading speed in any given direction of a general spatially periodic nonlocal equation. Such features are generic for nonlocal monostable equations in the sense that they are independent of the assumption of the existence of the principal eigenvalue of the linearized nonlocal dispersal operator at 0. Finally, under the above assumption we also investigate the front propagation feature for monostable equations with non-local dispersal in spatially periodic habitats. It remains open whether this feature is generic or not for spatially periodic nonlocal monostable equations.

- **Friday, Oct. 26**

Objective Bayesian Analysis of Vector Smoothing Spline

Shawn Xiaoguang Ni, Department of Economics, University of Missouri

We consider a multivariate smoothing problem with correlated error components (noise) and correlated derivatives of the vector components (signals). We relate the vector smoothing spline to a multivariate Bayesian Gaussian linear mixed model. We conduct full Bayesian inference on the smoothing spline and the unknown covariance matrices associated with the noise and signal components. We propose informative and objective priors under different parameterizations, provide conditions for posterior propriety under objective priors, and develop Markov Chain Monte Carlo (MCMC) algorithms for Bayesian computation. We show in numerical simulations that vector smoothing spline outperforms univariate smoothing splines. I will also present related topics on filtering time series data in macroeconomics.

- **Friday, Nov. 2**
  Restricted Partitions and Bernoulli Polynomials
  Boris Rubinstein, Stowers Institute for Medical Research

The problem of the partition of an integer number into a set of smaller integers has a long history starting from Leonhard Euler. The solution can be presented as a sum of the so-called Sylvester waves each corresponding to the divisor of the partition integers set. We present an explicit formula for the arbitrary Sylvester wave through the generalized Bernoulli and Euler polynomials. We also show that this formula can be written using the Bernoulli polynomials only.

- **Friday, Nov. 9**
  4:00 pm (note different time)
  An Introduction to Algebraic Methods for the Stochastic Shortest Path Problem
  Katherine Hastings, Department of Mathematics, University of Missouri

Operations research (OR) is an applied area of mathematics that can be thought of as the “theory of optimization.” A well-studied problem in OR is the shortest path problem, in which goal of the shortest path problem is to find the length of a shortest path between two specified locations. It is typically formulated on a network where nodes represent an abstraction of a set of elements and the connecting

edges/arcs indicate the relationship between these elements. In most real-world applications the "costs" of these relationships (edge/arc weights) are not known explicitly and are often modeled using random variables, thus giving rise to a *stochastic* network. The goal of the stochastic shortest path problem is to find the *probability distribution* of the shortest path length.

In this talk, we will introduce the stochastic shortest path problem as well as some of its applications. A new algebraic approach for solving the stochastic shortest path problem will then be presented and we will discuss an exact solution algorithm. We will also discuss approximate algorithms that can be employed using this algebraic technique to obtain bounding distributions. Lastly, we will examine the results obtained using these exact and approximating algorithms in two test networks.

- **Wednesday, Nov. 14 — Weller Overstreet Lectures in Science**
  Identifying Separated Time-scales in Stochastic Models of Cellular Reaction Networks
  Tom Kurtz, Department of Mathematics / Department of Statistics, University of Wisconsin—Madison

  Continuous time Markov chains have become a standard way of modeling chemical reaction networks in biological cells. The talk will begin with a review of some of the basic approaches for specifying and analyzing these models. In these models, reaction rates and chemical species numbers may vary over several orders of magnitude. Combined, these large variations can lead to subnetworks operating on very different time-scales. This separation of time-scales has been exploited in many contexts as a basis for reducing the complexity of dynamic models, but the interaction of the rate constants and the species numbers makes identifying the appropriate time-scales tricky at best. Some systematic approaches to this identification will be discussed and illustrated by application to one or more reaction network models.