Summary of MATH Colloquium Talks in academic year of 2016-2017

Date 9/30/2016
Speaker Meg Kiessling/Angelique Ramnarine/Tracy Hughes/Lani Gao, Department of Mathematics
Title Online Course Development
Abstract As the first generation of teaching online courses in mathematics, we will share our experience and thoughts in developing online math courses at different levels. Strategies for effective design, course structure and content, technical needs and resources, how to create video lectures, homework, quiz and exams etc. will be shared. Quality Matters standards and direction for future online course development will also be discussed.

Date 10/14/2016
Speaker Lin Mu, Oak Ridge National Lab
Title Weak Galerkin Finite Element Methods and Numerical Applications
Abstract Weak Galerkin FEMs are new numerical methods that were first introduced by Wang and Ye for solving general second order elliptic PDEs. The differential operators are replaced by their weak discrete derivatives, which endows high flexibility. This new method is a discontinuous finite element algorithm, which is parameter free, symmetric, symmetric, and absolutely stable. Furthermore, through the Schur-complement technique, an effective implementation of the WG is developed. Several applications of weak Galerkin methods will be discussed in this talk

Date 10/21/2016
Speaker Lingju Kong, Department of Mathematics

Title: On a quasilinear biharmonic equation

Abstract: In recent years, fourth order nonlinear differential equations have become increasingly popular due to their possible applications in the fields of image and signal processing, nuclear physics, and engineering. In this paper, we study the existence of positive radial solutions of the boundary value problem of the quasilinear biharmonic equation

$$\begin{cases} \Delta(|\Delta u|^{p-2}\Delta u) = f(|x|,u) + g(|x|), \ x \in B_1, \\ u = \Delta u = 0, \quad x \in \partial B_1, \end{cases}$$

where $B_1 = \{x \in \mathbb{R}^N \ : \ |x| < 1\}$ with $N \geq 2$, $x = (x_1, \cdots, x_N)$ and $|x| = \sqrt{x_1^2 + \cdots + x_N^2}$, $\Delta = \frac{\partial^2}{\partial x_1^2} + \cdots + \frac{\partial^2}{\partial x_N^2}$, $p > 1$ is a constant, $f : [0,1] \times [0,\infty) \to \mathbb{R}$ and $g : [0,1] \to \mathbb{R}$ are continuous, and $f(|x|, y)$ may be singular at $y = 0$. Using the function $g(t)$ in the problem, our results are presented in three cases in terms of different values of the expression $\int_0^1 k(\tau, s)g(s)ds$, where $k(\tau, s)$ is explicitly defined in the paper. The function $g(t)$ itself may be nonnegative, nonpositive, or sign-changing. For all the three cases, explicit lower and upper bounds are obtained for the solutions.

Date 10/28/2016
Speaker Hong Qin, Department of Computer Science
Title Network models of cellular aging and their applications
Abstract Biological aging is a complex phenotype with many genes involved, and is characterized by an exponential increase of mortality rate. A probabilistic gene network model will be presented to demonstrate that cellular aging can be an emergent property of gene networks. Results on empirical network models and simulation-based fitting will be presented. Methods will be presented to infer changes of gene interactions during aging by comparing viability of cells with mutations in gene pairs with special properties. Open mathematical and computational challenges will be discussed.

Date 11/4/2016
Speaker Billy Jackson, Department of Mathematics
Title Those Who Teach the Teachers: Knowledge Growth for Mathematics Teacher Educators
Abstract In this talk, we will examine what knowledge is required of mathematics teacher educators. I begin with some audience participation by asking members to complete two tasks: one at the elementary level and one at the secondary level. We will then have a discussion about what kinds of knowledge were required to complete these tasks. This will help us to begin to unravel what kinds of knowledge teachers need to have. Next, we will consider what kinds of knowledge we would need to *enact the tasks with teachers as teacher educators*. This activity will give rise to a concept that my colleagues and I call mathematical knowledge for teaching future teachers (MKTFT). I will review the existing models for mathematical knowledge for teaching in the literature and compare and contrast them with our model of MKTFT. The talk should have some significance for everyone in the math department as most of us teach preservice teachers at some stage: in addition, there will be a small flavor of dynamical systems modelling present as MKTFT is of a fractal nature as we shall see.

Date 11/18/2016
Speaker Lakmali Weerasena, Department of Mathematics
Title Approximation Algorithm For The Multiobjective Set Covering Problem
Abstract The multiobjective set covering problem (MOSCP), one of the challenging multiobjective combinatorial optimization problem, has received limited attention in the literature. In this study, an algorithm is presented to approximate the solution set (Pareto set) of the MOSCP. The proposed algorithm applies a local branching approach on a tree structure and is enhanced with a node exploration strategy specially developed for the MOSCP. The approach of this algorithm is to partition the search region into subregions based on the neighbors of a reference solution. Numerical experiments are conducted to check the performance of the proposed algorithm. Results on a performance comparison with benchmark algorithms from the literature show that the new algorithm is competitive.

Date 2/17/2017
Speaker Billy Jackson, Department of Mathematics
Title A Brave New World for Mathematics Teacher Education Programs:
The New AMTE Standards for Mathematics Teacher Preparation
Abstract Have you ever wondered about what mathematics content knowledge that K-8 teacher candidates should possess? How about what the mathematics content courses for K-8 teacher candidates should look like? If you answered yes, then I have just the place for you to start looking for answers! The Association of Mathematics Teacher Educators (AMTE) has just released a new document entitled Standards for Preparing Teachers of Mathematics. Just as the Common Core provides benchmarks for PreK-12 mathematics classrooms, so do the AMTE standards present benchmarks for programs in teacher education in producing highly qualified and effective teacher candidates. In this talk, we will examine what the AMTE Standards have to say about the mathematics content courses for K-8 teachers: i.e. what the design of such courses should look like, appropriate content for K-8 teacher candidates, appropriate models of instruction in these courses, etc. Discussions and consideration around these courses and the Standards themselves are vital for mathematics departments to have now as in the near future accreditation and licensing requirements of both future teacher candidates and teacher education programs are certainly most likely to be based upon the Standards.

Date 2/24/2017
Speaker Thandi Kingsbell, graduate student of Department of Mathematics
Title A Comparison Study of Statistical Modeling Strategies for Predicting Length of Hospital Stay in Patients with and without Enhanced Recovery After Surgery Protocol
Abstract Enhanced Recovery After Surgery (ERAS) protocols are programs incorporating multimodal interventions in the peri-operative period to expedite recovery. ERAS has been implemented in a variety of surgical specialties. Recent studies show that ERAS programs have shortened the length of hospital stay and reduced complication rates. In this prospective cohort study, 177 patients undergoing colon resection from 2011-2014 at Erlanger Hospital were compared with 68 patients who followed the implementation of ERAS from 8/2015 - 7/2016. Multiple statistical models such as Generalized Linear Models and Cox Regression models were applied and compared, to further investigate how ERAS affects the length of hospital stay with clinical covariates. This study has been conducted in collaboration with the UT College of Medicine and Erlanger Hospital.

Date 31/3/2017
Speaker Feng Bao, Department of Mathematics
Title High Performance Computing for Neutron Scattering Problems
Abstract We present a framework to use high performance computing to determine accurate solutions to the inverse optimization problem of big experimental data against computational models. We demonstrate how image processing, mathematical regularization, and hierarchical modeling can be used to solve complex optimization problems on big data. We also demonstrate how both model and data information can be used to further increase solution accuracy of optimization by providing confidence regions for the processing and regularization algorithms. We use the framework in conjunction with the software package SIMPHONIES to analyze results from neutron scattering experiments on silicon single crystals, and refine first principles calculations to better describe the experimental data.

Date 7/4/2017
Speaker Leigh Halliwell, Leigh Halliwell Company
Title Actuaries and Kronecker's Delta
Abstract If probability lays itself out in a "probability space," what is the geometry of that space? The basics of tensor algebra and calculus (K's δ) will be introduced, and through them idea of the probability density of a vector space will be expressed. At the least, tensor geometry should help actuaries to understand and to imagine statistical relations, especially regarding Maximum Likelihood estimation. Even better, actuaries who hook into mathematical physics may expect to reel in big fish.

Date 13/4/2017
Speaker Matthew Alger , graduate student of Department of Mathematics
Title Dimensionality Reduction and Regularization Regression Methods with Application to Prostate Cancer Study
Abstract In this study, we compare several statistical machine learning methods that can be used to relate prostate cancer to potential clinical predictors in prostate cancers study, where the number of variables is large (usually is far more than the number of samples). We applied Ordinary Least Squares Regression (OLS), Ridge Regression(RR), Elastic Net(EN), Principal Component Regression (PCR) and Partial Least Squares Regression (PLS) to a prostate cancer data with 97 patients. The performance of all these methods and the advantages of each method will be discussed.

Date 13/4/2017
Speaker Xin Dang, Department of Mathematics of the University of Misssissippi
Title Robust and Efficient Boosting Method using the Conditional Risk
Abstract Well-known for its simplicity and effectiveness in classification, AdaBoost, however, suffers from overfitting when class-conditional distributions have significant overlap. Moreover, it is very sensitive to noise that appears in the labels. This article tackles the above limitations simultaneously via optimizing a modified loss function (i.e., the conditional risk). The proposed approach has the following two advantages. (1) It is able to directly take into account label uncertainty with an associated label confidence. (2) It introduces a ``trustworthiness" measure on training samples via the Bayesian risk rule, and hence the resulting classifier tends to have finite sample performance that is superior to that of the original AdaBoost when there is a large overlap between class conditional distributions. Theoretical properties of the proposed method are investigated. Extensive experimental results using synthetic data and real-world data sets from UCI machine learning repository are provided. The empirical study shows the high competitiveness of the proposed method in predication accuracy and robustness when compared with the original AdaBoost and several existing robust AdaBoost algorithms.