COLLOQUIUM Fall 2002

Betsy Darken

Department of Mathematics,
University of Tennessee at Chattanooga

Thursday, September 5, Room 207, 2:45pm.

Learning How to Do It or Why It Works: Which Should Come First?

Abstract. In any discipline, learning is often categorized into two types, conceptual and procedural. Roughly speaking, the former concerns "why" while the latter concerns "how." In mathematics education, there is considerable debate related to these types of learning. One issue concerns the relative importance of conceptual and procedural learning at various grade levels. For instance, do fifth graders need to understand what 1/5 x 10 means, or how to compute the answer, or both? A second concerns the order in which these types of learning should occur. If, for example, you believe that fifth graders should develop both a procedural and a conceptual understanding of 1/5 x 10, which should they learn first? Or is this the wrong question? In this talk, I will discuss research related to these issues, along with implications for the mathematics education of future teachers. I will specifically discuss the manuscript I am currently using for the latter.

Terry Walters and Stephen Kuhn

Department of Mathematics,
University of Tennessee at Chattanooga

Thursday, September 19, Metro 205, 2:00pm.

An Open Web-Based Homework System

Abstract. We will discuss and give a hands-on demonstration of WHS, the web-based homework system developed at the University of Kentucky (UK). This system, developed with funding support from NSF, is in use at UK, UTC, and other institutions. It allows instructors to set up their own classes and use homework sets or individual problems developed by other instructors or they may post their own problem sets. WHS shares much functionality with other web-based homework systems, including random selection of problems, immediate grading of the homework and feedback to students and faculty, and opportunities for email between student and instructor with clear problem references. However, unlike these other systems WHS homework sets can be written in many programs, including Word, Maple, and Mathematica with a small set of easily learned tags. We create all of our problem sets in Maple for easy inclusion of 2- and 3-dimensional graphs.

Scott Marshall, Sonja Petrovic, and Daniel Stover,

students,
University of Tennessee at Chattanooga

Tuesday, October 8, Metro 207, 2:00pm.

Summer Experience of Mathematics Majors

Abstract. The following UTC students had a very interesting experience this summer. Scott Marshall had a summer internship at Blue Cross/Blue Shield; Sonja Petrovic had a RUE (research for undergraduate experience) at Wooster Poly; and Daniel Stover had a RUE at Northern Arizona. They will give a brief overview of their summer experiences and open it up to questions. We are hoping that interested students will come and learn about programs they might be interested in. We are asking all Math Professors to inform the students in their classes.

We are planning on doing this in conjuction with the Pizza Party.

Charles Johnson
College of William and Mary

Friday, October 25, Metro 207, 2:00pm.

Matrix Factorizations

Abstract. Decomposition of a given matrix into a product of two or more other matrices is fundamental both to the theory and the application of matrices (including computation). In this talk we discuss several classical factorizations (including new information about them) and some new factorizations. Much of the talk will be accessible at the level of an elementary course in linear algebra, but a few things will be relatively specialized.

Professor Ming-Jun Lai,
Dept. of Mathematics,
University of Georgia, Athens, GA

Thursday, November 14, Metro 207, 2:45pm.

Graduate Studies at UGA and Multivariate Splines for PDE

Abstract. I will make a powerpoint presentation of graduate studies at Department of Mathematics, University of Georgia. In particular, the research groups, their research subjects, graduate student group, as well as the VIGRE program will be introduced. Then I will present a talk based on my research. I will introduce a multivariate spline method for numerical solution of partial differential equations. The multivariate splines are piecewise polynomial functions with certain smoothness. I will show how to use these spline functions of arbitrary degrees and smoothness to numerically solve PDE's without constructing locally supported basis functions, finite elements, or macro-elements. Some numerical examples of 2D and 3D Navier-Stokes equations will be shown.
I will bring some application information for graduate studies at UGA with me.

Boris P Belinskiy,
University of Tennessee at Chattanooga
and
Sergei A Avdonin,
University of Alaska Fairbanks

Thursday, November 7, Metro 207, 2:45pm.

Some New Developments in the Exact Control Theory

Abstract. We study the exact controllability for a flexible elastic string fixed at the end points under an axial stretching tension. The tension is a sum of two terms, a constant tension and a slowly variable load. We say that the string is controllable if it is possible to choose the transverse load $g(x)f(t)$ such that the string goes to the rest. To prove our results we apply the method of moments. This has been widely used in control theory of distributed parameter systems since the classical papers of H.O. Fattorini and D.L. Russell in the late 60s to early 70s. The problem of exact controllability is reduced to a moment problem for the control $f(t)$. The proof of controllability is based on an auxiliary basis property result.
The results of this paper may be considered as a generalization of the classical results by H.O. Fattorini and D.L. Russell. The main difference between our problem of control and the previous problems is that the coefficient of the wave equation (tension) is a function of time. As a result, the functions that substitute non-harmonic exponential functions even may not be found explicitly. This fact sufficiently complicates the analysis of controllability. To our best knowledge it is the first attempt to apply the method of moments to equations with time dependent coefficients.
Students who have already taken the first courses in ODE (#245) and Linear Algebra #212) will be able to understand the idea of the proof.

Yongzhi Xu,
University of Tennessee at Chattanooga

Tuesday, February 11, Metro 161, 2:00pm.

Free Boundary Problem Model of Ductal carcinoma in situ

Abstract. In this talk we will present analytical and numerical results of our ongoing research in mathematical modeling of Ductal carcinoma in situ (DCIS).

DCIS refers to a specific diagnosis of breast cancer that is isolated within the breast duct, and has not spread to other parts of the breast. In a recent talk Mary Edgerton of Vanderbilt University described two special patterns found in DCIS: one lining up like baby trees and one spreading out evenly. We modify a model proposed by Byrne and Chaplain for the growth of a tumor consisting of live cells (nonnecrotic tumor) to describe the homogeneous growth inside a rigid cylinder, a model mimicking the growth of a ductal carcinoma. The model is in the form of a free boundary problem. The analysis of stationary solutions of the problem shows that this model has five tumor patterns that mimic some typical patterns of DCIS, including the types described by Edgerton. The analysis shows that there may be two other kinds of patterns that resemble the non-growing tumor. We also show for the solid DCIS case (one-dimensional case) that the stationary solution is unstable.

This talk presents a typical example of mathematical modeling, analysis and computational bio-engineering. Students with basic calculus will be able to understand the problem, the ideas and the computational results, though some mathematical analysis may require knowledges of multivariable calculus (Math 255), differential equations (Math245) and more advanced mathematics.

Marc Loizeaux,
University of Tennessee at Chattanooga

Tuesday, March 4, Metro 161, 2:00 pm.

Sampling Perfectly from a Bayesian Cluster Model

Abstract. A Bayesian cluster model for spatial point processes is presented, in which observations are assumed to cluster around a finite collection of underlying landmarks. The prior and likelihood are modeled as locally stable point processes. We also assume that, for all data sets, the Papangelou conditional intensities for the likelihood have a common lower bound. Under these mild conditions the posterior is shown to be locally stable on its support.

We obtain "snapshots" of our posterior distribution using Markov chain Monte Carlo techniques. Typically, an MCMC sampler obtains samples from distributions that are "close to" the desired distribution. But due to the local stability of our posterior we are able to obtain an exact draw from the desired distribution via an algorithm of Kendall and Mller. Thus we discuss the idea of "perfect" sampling, in which a chain is run from the distant past, and at time T=0 a sample from the desired distribution is achieved.

An application to disease clustering, using leukemia location data from upstate New York, is presented. We also present potential future applications, some of which served to motivate the model presented.

Most of the ideas in this talk will be presented with a goal towards intuitive understanding for students with some knowledge of statistics and calculus.

Jianping Zhu
The University of Akron, Arkon, OH

An Efficient High-Order Algorithm
for Solving Systems of 3-D Reaction-Diffusion Equations

Tuesday, March 25, Metro 161, 3:30 pm.

Abstract. An efficient higher-order finite difference algorithm for solving systems of 3-D reaction-diffusion equations with nonlinear reaction terms will be discussed in this presentation. The algorithm is fourth-order accurate in both the temporal and spatial dimensions. It requires only a regular seven-point finite difference stencil similar to that used by most second-order algorithms, and is more efficient than the standard compact finite difference algorithms that include derivatives as unknowns.

Billur Kaymakcalan
Department of Mathematics and Computer Science,
Georgia Southern University, Statesboro, GA

Nagumo type existence result for a second order nonlinear dynamic PBVP

Friday, April 4, Metro 161, 2:00 pm.

Abstract. Nagumo growth condition is a well known tool in deriving existence results for nonlinear second order ordinary differential equations that depend continuously on the first derivative. Roughly speaking, the classical Nagumo condition [1,2] allows the nonlinear part of the treated equation to be a quadratic polynomial in y'. Such a condition warrants an a priori uniform bound of all possible solutions of the considered problem. The proof is based on the intermediate value theorem and the chain rule theorem.

In this talk we present a Nagumo condition that includes as a particular case a type of the classical one for differential equations involving a certain restriction. The established Nagumo condition further allows us to prove the existence of at least one solution lying between a pair of lower and upper solutions of the nonlinear second order dynamic problem

$$y^{\triangle\triangle}(t) = f(t, y^{\sigma(t)},\ \ y^{\triangle}(\sigma(t))),\ \ t \in [a, b],\ \ y(a) = y^{\sigma}(b);\ \ y^{\triangle}(a) = y^{\triangle}(\sigma(b)),$$

with f being a continuous function, $[a, b] = \{t \in T,\ a \leq t \leq b\}$ and T an arbitrary time scale. The proof lies heavily on the chain rule theorems for time scales given in [3].

References:
[1] M. Nagumo. Ueber die Diferentialgleichung $y'' = f(x, y, y')$. Proc. Phys.-Math. Soc. Japan (3)19:861-866, 1935.
[2] S. R. Bernfeld, and V. Lakshmikantham. An Introduction to Nonlinear Boundary Value Problems. Math. Sci. Engr. 109, Academic Press, New York, 1974.
[3] M. Bohner, and A. Peterson. Dynamic Equations on Time Scales; An introduction with Applications. Birkhauser Boston, Inc., Boston, MA, 2001.

This is a joint work with Alberto CABADA and Chuan Jen CHYAN

Teresa W. Haynes,
East Tennessee State University,
Christine Mynhardt,
University of South Africa,
Lucas C. van der Merwe
University of Tennessee at Chattanooga

Tuesday, April 8 , Metro 161, 2:00pm.

Total Domination Edge Critical Graphs with Minimum Diameter

Abstract. A set S of vertices of a graph G is a total dominating set if every vertex of $V(G)$ is adjacent to some vertex in S. The total domination number of G, denoted by $\gamma_t(G)$, is the minimum cardinality of a total dominating set of G. A graph G is said to be total domination edge critical, or simply γ_t-critical, if $\gamma_t(G+e) < \gamma_t(G)$ for each edge $e \in E(G)$. For 3_t-critical graphs G, that is, γ_t-critical graphs with $\gamma_t(G)=3$, the diameter of G is either 2 or 3. We study the 3_t-critical graphs G with $diam G = 2$.

Ossama A. Saleh / Ronald L. Smith

**Department of Mathematics,
University of Tennessee at Chattanooga**

Thursday, April 17 , Metro 161, 2:00pm.

The Elliptic Matrix Completion Problem

Abstract. An elliptic matrix is a real symmetric matrix which has exactly one simple positive eigenvalue. A partial matrix is a rectangular array with some entries specified, and the other (unspecified) entries free to be chosen. A completion of a partial matrix is a choice of values for the unspecified entries, resulting in a conventional matrix. A matrix completion problem is the question of whether a partial matrix has a completion in a certain class or, equivalently, with a certain property of interest. Typically, the question is answered from a graph-theoretic point of view, i.e. , for what patterns of the specified entries (resulting in an undirected graph on the vertices 1,2,..., n) are we ensured of a completion in a certain class. In this talk the elliptic matrix completion problem will be analyzed, drawing both parallels to and differences from the well studied positive definite completion problem.

The talk should be accessible to anyone with a good knowledge of eigenvalues/eigenvectors at the sophomore linear algebra level and assumes no knowledge of the necessary graph theory concepts.