Spring 2011

2011 (Spring)

University of Dayton. Department of Mathematics

Abstracts of the Colloquium Talks: Spring 2011
Department of Mathematics

Date	Speaker and Title	Time/Location
Thursday, Jan 20	Paul Eloe, University of Dayton Positive Solutions of Impulsive Ordinary Differential Equations with Nonlinear Boundary Conditions	3:00 PM, SC 323
Thursday, Jan 27	Paul Eloe, University of Dayton Positive Solutions of Impulsive Ordinary Differential Equations with Nonlinear Boundary Conditions	3:00 PM, SC 323
Thursday, Feb 3	Jialin Zhao, University of Dayton A Lattice Method for Option Pricing with Two Underlying Assets (in Regime-Switching Model)	3:00 PM, SC 323
Thursday, Feb 10	Josh Cain, University of Dayton Coarser Pathwise-Connected Topologies of Metric Spaces	2:00 PM, SC 216
Thursday, Feb 17	Art Busch, University of Dayton Algorithms for distance-k matchings in weakly chordal and dually chordal graphs	3:00 PM, SC 323
Thursday, Feb 24	Paul Eloe, University of Dayton Gronwall's Inequality in Discrete Fractional Calculus	3:00 PM, SC 323
Thursday, Mar 10	Kraig Kirchner, University of Dayton Estimation Methods for Missing Observations in Unreplicated 2^k Factorial Designs	3:00 PM, SC 323
Thursday, Mar 17	Nasrin Sultana, University of Dayton Calculating Determinants and Inverses of Block Matrices	3:00 PM, SC 323
Thursday, Mar 24	Craig Birkemeier, University of Dayton Effect of Dominance Theorems on the Single-Machine Weighted Tardiness Problem	3:00 PM, SC 323
Thursday, Mar 31	Ruihua Liu, University of Dayton Optimal Stopping Problems in the Regime-Switching Model	3:00 PM, SC 323
Thursday, April 7	Nasrin Sultana, University of Dayton Periodic Solutions of Neutral Delay in Integral Equations of Advanced Type	3:00 PM, SC 323
Thursday, Apr 14	Kevin Pond, Air Force Institute of Technology Multidimensional Adaptive Quadrature Over Simplices	3:00 PM, SC 323
Tuesday, April 19	Weidong Li, University of Dayton How to Use Upper and Lower Solution to Solve Double Barriers Option Problem	3:00 PM, SC 323
Tuesday, April 19	Kraig Kirchner, University of Dayton Estimation Methods for Missing Observations in Unreplicated 2^k Factorial Designs and 2^{k-p}Fractional Factorial Designs	3:30 PM, SC 323

Tuesday, April 26	Schautan Reed, University of Dayton Crystal Ball	3:00 PM, SC 323
Tuesday, April 26	Chaunjie Zhang, University of Dayton Idiosyncratic Risk and the Cross Section of Stock Returns – A Quantile Regression Approach	3:30 PM, SC 323
Thursday, Apr 28	Jialin Zhang, University of Dayton A Lattice Method for Option Pricing with Two Underlying Assets in Regime-Switching Model	3:00 PM, SC 323
Thursday, Apr 28	Craig Birkemeier, University of Dayton Effect of Dominance Theorems on the Single-Machine Weighted Tardiness Problem	

Positive Solutions of Impulsive Ordinary Differential Equations with Nonlinear Boundary
Paul Eloe
Abstract: A well-know compression - expansion cone theoretic fixed point theorem is applied to an impulsive ordinary differential equation with nonlinear boundary conditions. In the case of a nonlinear ordinary differential equation with linear boundary conditions, it is routine to apply the fixed point theorem in the case of sublinear or superlinear nonlinearities. We examine the impact of analogous nonlinearities in the impulses and boundary conditions.

A Lattice Method for Option Pricing with Two Underlying Assets (in Regime-Switching Model)
Jialin Zhao
Abstract: The lattice binomial model developed by Cox, Ross, and Rubinstein (CRR) demonstrates that options, with one underlying asset, can be priced by discounting their expected value with risk-neutral probabilities. An extension of this model is introduced first when there are two underlying assets governed by constant regime parameters. Valuation algorithm is established with details given on how the jump probabilities and jump amplitudes may be obtained, and numerical examples are performed to illustrate method accuracy. Based on it, a CRR option evaluation algorithm in regime-switching models is developed.

Coarser Pathwise-Connected Topologies of Metric Spaces
Josh Cain
Abstract: Given a set X and a metric d, we can condense the topology on X generated by d by finding a new metric d' on X such that any subset of X that is open under d' is also open under d. In this case, we call the topology generated by d' a coarser topology of that generated by d. Recent research in topology has been concerned with determining the properties that a given disconnected space must possess in order for there to exist a coarser topology on that space that makes it connected. If we instead require that the coarser topology be pathwise-connected (a stronger condition than connectivity), we need to re-evaluate many of these results in light of this new topological restriction. Focusing on direct sums and subsets of connected spaces, we examine which conditions that are sufficient for a space to have a coarser connected topology generalize to the pathwise-connected case.

Algorithms for distance-k matchings in weakly chordal and dually chordal graphs
Art Busch

Abstract: A distance-k matching in a graph is a set of edges such that any path containing two of the edges has length at least $k + 2$. For general graphs, no polynomial-time algorithm is known to find a largest distance-k matching for any > 1 . In this talk we will present algorithms to find a largest distance-k matching in a weakly chordal graph when k is even, and a related algorithm for finding a largest distance-k matching in a dually chordal graph when k is odd.

Gronwall's Inequality in Discrete Fractional Calculus

Paul Eloe

Abstract: The construction and applications of Gronwall's inequality to ordinary differential equations will be reviewed. A related inequality will be derived in the case of discrete fractional calculus. To do so, there will be an introduction to discrete fractional calculus to develop the notations and methods used to derive the inequality.

Estimation Methods for Missing Observations in Unreplicated 2^k Factorial Designs

Kraig Kirchner

Abstract: Because each effect is dependent on every observation, missing observations in factorial designs can drastically alter effects. Such experimental biases can be detected by examining half-normal plots of effects. The inactive absolute effects in these plots should approximately point toward the origin. If this isn't the case, analysis of original experiment needs to be employed to determine which observation is causing bias. Once missing observation is determined, estimation methods will need to be used to restore orthogonal structure to the design. After estimation, the half-normal plot of newly calculated effects needs to be examined again. If insignificant absolute effects approximately point to the origin, then bias has been removed from the experiment. If not, a new estimation method should be introduced. In my research, I have examined current, popular estimations methods, and I have attempted to introduce new estimation methods of my own.

Calculating Determinants and Inverses of Block Matrices

Nasrin Sultana

Abstract: Some general formulas for calculating determinants and inverses of block matrices are derived. Laplace's Expansion is employed for block diagonal and block triangular matrices. Schur's complement extends these formulas to full block matrices. We consider the case of 2×2 block matrices in which at least one block is invertible (and hence, square). We also consider the case of 2×2 block matrices of dimension $2n$ in which each block is a square matrix of dimension n.

Effect of Dominance Theorems on the Single-Machine Weighted Tardiness Problem

Craig Birkemeier

Abstract: In single-machine job scheduling problems, there are n jobs to be assigned in n positions with each job i defined by a processing time p_i due date d_i and weight w_i. One of the key performance metrics of a job schedule is the weighted tardiness, which is the sum of each job's weight times its tardiness ($(\sum_{i=1}^{n} w_i T_i)$ Job tardiness is defined as $T_i = \max\{0, C_i - d_i\}$, where C_i is the job's completion time in the schedule. I am using a branch and bound method to solve these problems. In the worst case, branch and bound will consider all $n!$ possible solutions, but it is most effective when the bounding procedure can eliminate most of these solutions before they are explored. The bounding procedure used is the Hungarian algorithm to assign each unscheduled job to a position in the sequence. This branch and bound method is used to determine the effect of dominance theorems developed by Kanet (2011) on solving single-machine weighted tardiness problems.

Optimal Stopping Problems in the Regime-Switching Model
Ruihua Liu
Abstract: Optimal stopping is a class of stochastic optimal control problems that has many applications in mathematical finance (e.g., American options, selling rules). In this talk I will present the optimal stopping problem formulation using the regime-switching model, the method of solution, and preliminary results.

Periodic Solutions of Neutral Delay in Integral Equations of Advanced Type
Nasrin Sultana
Abstract: We study the existence of continuous periodic solutions of a neutral delay integral equation of advanced type. In the analysis we employ three fixed point theorems: Banach, Krasnosel'skii, and Krasnosel'skii-Schaefer. Krasnosel'skii-Schaefer fixed point theorem requires an a priori bound on all solutions. We employ a Liapunov type method to obtain such bounds.

Multidimensional Adaptive Quadrature Over Simplices
Kevin Pond
Abstract: Multidimensional integration appears in several fields, for example: statistical mechanics, the evaluation of financial derivatives, the discretization of partial differential equations with random inputs, integral equations and the numerical computation of path integrals, to name a few. However, the effectiveness of state of the art methods that approximate these integrals is limited by the smoothness of the integrand and the "curse of dimensionality." In other words, problems arise when dealing with functions that have discontinuities and even for smooth functions the computing cost grows exponentially with the increasing number of dimensions in the problem. In this talk I present a method that effectively approximates the integral of piecewise continuous functions in two to seven dimensions.

About the speaker: In 2005 Capt Pond earned his commission after achieving his Masters in Mathematical Science at the University of Texas at Dallas. He then went to Edwards AFB in southern California where he worked on the CV-22 Osprey and MQ-9 Reaper as an Operations Specialist. There he designed and implemented operational tests for the weapon systems, assuring their readiness for fielding. Because of academic and operation achievement, Capt Pond was then sent to Virginia Polytechnic Institute and State University (Va Tech) to earn his PhD. Working under Jeff Borggaard, Capt Pond focused on numerical problems inspired by uncertainty quantification and parameter identification. Now Capt Pond is an Assistant Professor of Mathematics in the Department of Mathematics and Statistics at The Air Force Institute of Technology (AFIT).

Refreshments at 2:30 PM in SC 313
Talk at 3:00 PM in SC 323.

How to Use Upper and Lower Solution to Solve Double Barriers Option Problem
Weidong Li
Abstract: A method to calculate the price of European call option will be introduced which has lower and upper barriers. It is more convenient than the finite difference method and much faster than Monte

Carlo simulation. The data obtained with this method will be compared to the data obtained using a Monte Carlo simulation.

Estimation Methods for Missing Observations in Unreplicated 2^k Factorial Designs and 2^{k-p} Fractional Factorial Designs

Kraig Kirchner

Abstract: In 2^k Factorial Designs and 2^{k-p} Fractional Factorial Designs each effect is dependent on every observation. Therefore, missing observations in factorial designs can drastically alter these effects. To restore orthogonal structure to the design, estimation methods need to be employed. After estimation, the half-normal plot of effects needs to be examined. If insignificant effects approximately point toward the origin, then we have a proper estimation. Current, popular estimation methods sacrifice effects in order to calculate missing observations. In my research, I have attempted to create new estimation methods without explicitly sacrificing effects.

Crystal Ball

Schautan Reed

Abstract: A statistical tool, Crystal Ball, is used to calculate risk in proposed budgets for some government agencies. We shall introduce the 5-step process of a Program Office Estimate, a government requirement and show how Crystal Ball is employed in this process to compute risks.

Idiosyncratic Risk and the Cross Section of Stock Returns – A Quantile Regression Approach

Chuanjie Zhang

Abstract: The capital asset pricing model (CAPM) proposed by Sharpe (1964), Lintner (1965), and Black (1972) implies a positive relation between systematic risk and stock returns, while other risk should possess no relation with the expected returns as they are diversifiable in the context of portfolio. However, literature show evidence that there exist relation between idiosyncratic risk and stock returns. Merton (1987) posits that investors will care about an asset's total risk, not just systematic risk, if they cannot hold the market portfolio. Echo Merton's argument, Tinic and West (1986), Lehman (1990), Malkiel and Xu (1997), Malkiel and Xu (2002), and Fu (2009) find significant and positive relation between idiosyncratic risk and stock returns empirically.

Bali and Cakici (2008), however, posit that there is no robust relation between idiosyncratic volatility and stock expected return. Therefore, the relation between idiosyncratic risk and stock return is far from conclusive, and it is our intention to shed light on this strand of the literature. Given the conflicting results in the relation between idiosyncratic risk and expected stock returns, this study reexamines this issue using a quantile regression approach. Since OLS regression models estimate only the conditional mean of the relation between idiosyncratic risk and stock returns, the results do not allow for the differential tail behavior of stock return distribution, which quantile regression models are more informative.

The use of quantile regression allows us to separate the relation between idiosyncratic volatility and expected returns of high performance stocks/portfolios from low performance stocks/portfolios, and examine if the relation is robust and/or homogeneous across quantiles of return distribution. The results may help explain the existence or non-existence of such relation.

A Lattice Method for Option Pricing with Two Underlying Assets in Regime-Switching Model

Jialin Zhao

Abstract: The binomial tree model developed by Cox, Ross, and Rubinstein proposes a lattice model for stock price movement, and demonstrates that options can be priced by discounting their expected value with risk-neutral probabilities. One controversial assumption underlying this model is that the market regime parameters, such as interest rate and asset volatility, remain constant over time. This work intends to incorporate regime-switching component into an extension of the binomial tree model in order to estimate options with two underlying assets more accurately. Valuation algorithm is established with details given on how the jump probabilities and jump amplitudes may be obtained, and numerical examples are performed to illustrate method accuracy.

Effect of Dominance Theorems on the Single-Machine Weighted Tardiness Problem

Craig Birkemeier

Abstract: In single-machine job scheduling problems, there are n jobs to be assigned in n positions of a sequence with each job i defined by a processing time p_i, due date d_i and weight w_i . One of the key performance metrics of a job schedule is weighted tardiness, which is the sum of each job's weight times its tardiness ($\Sigma_{i-1}^{n} w_i T_i$). Job tardiness is defined as $T_i = max\{0, C_i - d_i\}$, where C_i is the job's completion time in the schedule. I am using a branch and bound method to test the effect of using dominance theorems developed by Kanet (2011) in solving these problems, specifically using them at each step of a branch and bound versus using them only prior to a branch and bound.