Spring 2012

2012 (Spring)

University of Dayton. Department of Mathematics

Abstracts of the Colloquium Talks: Spring 2012
Department of Mathematics

Date	Speaker and Title	Time/Location
Thursday, Jan 19	Youssef Raffoul, University of Dayton Periodicity in General Delay Nonlinear Difference Equations Using Fixed Point Theory	3:00 PM, SC 323
Thursday, Jan 26	Joshua Craven, University of Dayton Initial Development of a Statistically Based Validation Process for Computational Simulation	3:00 PM, SC 323
Thursday, Feb 2	Ziqi Qiao, University of Dayton Idiosyncratic risks in different regimes and the cross-section of expected stock returns	3:00 PM, SC 323
Thursday, Feb 9	Muhammad Usman, University of Dayton Bifurcation Analysis for a Class of Nonlinear Partial Differential Equations Using a Perturbation Method	3:00 PM, SC 323
Thursday, Feb 16	Saber Elaydi, Trinity University Stability, bifurcation and invariant manifolds of some competition models	3:00 PM, SC 323
Thursday, Feb 23	Paul Eloe, University of Dayton A Limiting Behavior of a Solution of the (2n)th Order Lidstone Boundary Value Problem	3:00 PM, SC 323
Thursday, Mar 8	Jeffrey Neugebauer, Eastern Kentucky University Extremal Points for a Fourth Order Boundary Value Problem	3:00 PM, SC 323
Thursday, Mar 15	William Fleissner, University of Kansas When Cp(X) is domain representable	3:00 PM, SC 323
Thursday, Mar 22	Richard Warr, Air Force Institute of Technology Bayesian Semi-Markov Models for Combining Heterogeneous Reliability Data	3:00 PM, SC 323
Thursday, Mar 29	Louis DeBiasio, Miami University The co-degree threshold of the Fano plane	3:00 PM, SC 323
Thursday, Apr 12	Bader Masry and Emad Michael, University of Dayton Role of resolvent in perturbed nonlinear Volterra integral equation	3:00 PM, SC 323
Thursday, Apr 12	Wesley Jones, University of Dayton Exponential Stability and Instability Via Lyapunov Functionals	**3:30 PM, SC 323**
Thursday, Apr 19	Ahlam Alraddadi, University of Dayton Modeling volatility: ARCH and GARCH models	3:00 PM, SC 323
Thursday, Apr 19	William Balbach, University of Dayton Decomposition of complete multipartite graphs into the graph pair of order 4	**3:30 PM, SC 323**

Friday, April 20	Ziqi Qiao, University of Dayton Idiosyncratic risks in different regimes and the cross-section of expected stock returns	**2:00 PM, SC 379**
Friday, April 20	Danping Wang, University of Dayton On credit risk-downgrade risk prediction	**2:30 PM, SC 379**
Thursday, Apr 26	Ramzi Nahhas, Wright State University Constructing Conditional Reference Values for Childhood Skeletal Age and Predicting the Timing of Maturational Spurts	3:00 PM, SC 323

Periodicity In General Delay Nonlinear Difference Equations Using Fixed Point Theory
Youssef Raffoul
Abstract: Using Schaefer's fixed-point theorem, enabling us to show that if there is an a priori bound on all possible T −periodic solutions of

$$\Delta x(n) = F(n, x_n),$$

then there is a T −periodic solution. The a priori bound will be established by different methods including non-negative Lyapunov functionals. Examples illustrating the developed theory are provided.

Initial Development of a Statistically Based Validation Process for Computational Simulation
Joshua Craven
Abstract: A newly-developed, statistically-based, process for validation of computational experiments is presented. The focus of this newer methodology is Uncertainty Quantification, sensitivity analysis, and variance reduction. Design of Experiments is used to stabilize the initial test conditions for training data set for the initial calibration simulations. Newly-developed MATLAB toolboxes for system identification and variance reduction are used to modify the response functions to minimize the differences and uncertainty of the results. These toolboxes identify the areas with the greatest variance and add relevant data points to reduce the variance in these areas. Gaussian process regression methodologies are used to reduce the variances and differences from the simulation results compared to the validation data. The standard computational validation process is presented as a comparison to the proposed statistically-based process. Results of the new process indicate that significant uncertainty reduction as well as variance reduction is achieved with minimal number of test runs, resulting in superior performance prediction for the computational models.

Idiosyncratic risks in different regimes and the cross-section of expected stock returns
Ziqi Qiao
Abstract: The relation between idiosyncratic risks and the cross-section of expected stock returns are examined with consideration of regime shifts. Bai-Perron test is applied to test the number of regime shifts and the corresponding break dates. Then, GARCH model is applied to estimate the conditional idiosyncratic risks in each regime obtained. In the end, OLS is used to examine the relation of idiosyncratic risks and expected stock returns.

Bifurcation Analysis for a Class of Nonlinear Partial Differential Equations Using a Perturbation Method
Muhammad Usman

Abstract: In this talk some results on bifurcations in steady state solutions of a class of nonlinear dispersive wave equation and for a damped externally excited Kuramoto-Sivashinsky Equation will be presented. Using an asymptotic perturbation method stability of solutions will be discussed. We consider the primary resonance by defining the detuning parameter. External-excitation and frequency-response curves are shown to exhibit jump and hysteresis phenomena for the models.

Stability, bifurcation and invariant manifolds of some competition models

Saber Elaydi

Abstract: In this talk we will present recent results on stability of some planar competition models represented by difference equations. This is accomplished utilizing the theory of center manifolds. Finally we describe the bifurcation scenario of the system that includes period-doubling bifurcation and saddle-node bifurcation.

A Limiting Behavior of a Solution of the $(2n)$th Order Lidstone Boundary Value Problem

Paul Eloe

Abstract: The $2n$th order Lidstone boundary value problem has the form

$$u^{(2n)}(t) = f\big(t, u(t)\big), \quad 0 < t < 1,$$
$$U^{(2j)}(0) = u^{(2j)}(1) = 0$$

George Lidstone (1870-1952) was a British actuary and he seems to be best know for contributions to statistics (Lidstone smoothing). He also made contributions to interpolation theory, an immediate application of boundary value problems for ordinary differential equations.

When $n = 1$, the Lidstone problem reduces to a standard second order ordinary differential equation with Dirichlet boundary conditions. When $n = 2$, the fourth order boundary value problem has applications in elasticity and is often referred to as a beam problem or a cantilever beam problem.

In a recent article, Bo Yang (JMAA, 382 (2011), 290 – 302) studies this problem for large n. Among other things, he shows that in the limit, solutions of the Lidstone problem are closely related to the eigenvalue problem,

$$u''(t) = \lambda u(t), \quad 0 < t < 1,$$
$$u(0) = u(1) = 0.$$

In this talk, we provide sufficient information so that the talk is self-contained and we obtain the limiting results produced by Yang.

Extremal Points for a Fourth Order Boundary Value Problem

Jeffrey T. Neugebauer

Abstract: We characterize extremal points for a fourth order three point boundary value problem $u^{(4)} + p(x)u = 0$, for $0 \le x \le \beta, u(0) = u'(r) = u''(r) = u'''(b) = 0$, where r and β are fixed and $0 < r \le b \le \beta$. We establish the existence of a largest interval, $[0, b)$, such that on any subinterval $[0, c]$ of [0,b), there exists only the trivial solution of this fourth order boundary value problem. We accomplish this by characterizing the first extremal point through the existence of a nontrivial solution that lies in a cone by establishing the spectral radius of a compact operator. We then use a substitution method to reduce the nth order problem to a fourth order problem in order to characterize the first extremal point of the nth order three point boundary value problem.

About the speaker: Dr. Neugebauer earned bachelors and master's degrees at the University of Dayton. For the master's degree, he did his research with Dr. Muhammad Islam. He earned a Ph.D. in mathematics from Baylor University in May, 2011 and is now on the faculty in the Department of Mathematics at Eastern Kentucky University.

Refreshments will be served beginning at 2:30 in SC 313F.

WHEN $C_p(X)$ IS DOMAIN REPRESENTABLE
William Fleissner

Abstract: If X and R are topological spaces, then we denote the set of continuous functions from X to R by $C(X,R)$. If R is a group, or lattice ring, etc., then $C(X,R)$ has the same algebraic structure, defining operations pointwise. For example, $(g + h)(x) := g(x) + h(x)$. In particular, $(C(X,\mathbb{R}),+)$ is a subgroup of $(\mathbb{R}^X +)$. We write $C_p(X,R)$ when we consider $C(X,R)$ as a subspace of the usual, finite support, product topology on R^X . This is the topology of pointwise convergence on $C(X,R)$. We write $C(X)$ for $C(X,\mathbb{R})$ and $C_p(X)$ for $C_p(X,\mathbb{R})$. We show that if X is completely regular and $C_p(X)$ is domain representable, then X is discrete, and if X is zero-dimensional, T_2 and $C_p(X,\mathbb{2})$ is subcompact, then X is discrete.

Bayesian Semi-Markov Models for Combining Heterogeneous Reliability Data
Richard Warr
Abstract: Modern complex engineering systems often present the analyst with a mix of data types that can be used for reliability prediction: system test results, lifetime data from unit tests of components and subsystems, and degradation data that may have predictive value for component lifetimes.

We present a hierarchical semi-Markov framework in which state transitions are driven by component failure and repair, and time-to-event distributions may be estimated from sample data or generated by submodels for degradation and other physical failure mechanisms. By applying a Bayesian methodology, the framework can incorporate prior information (including expert opinion) for waiting time distributions, as well as sequential updating with lifetime data from system tests.

The co-degree threshold of the Fano plane
Louis DeBiasio
Abstract: Given a 3-graph H, let $ex_2(n,H)$ denote the maximum codegree of a 3-graph on n vertices which does not contain a copy of H. Let $\mathbf{F}$ denote the Fano plane, which is the 3-graph $\{axx', ayy', azz', xyz', xy'z, x'yz, x'y'z'\}$. Mubayi proved that $ex_2(n,\mathbf{F}) = (1/2 + o(1))n$ and conjectured that $ex_2(n,\boldsymbol{F}) = [n/2]$ for sufficiently large n. Using a very sophisticated quasi-randomness argument, Keevash proved Mubayi's conjecture. Here we give a simple proof of Mubayi's conjecture by using a class of 3-graphs that we call rings. We also determine the Tur´an density of the family of rings.

This work is joint with Tao Jiang of Miami University.

Role of resolvent in perturbed nonlinear Volterra integral equation
Bader Masry and Emad Mikael
Abstract: We consider the perturbed nonlinear Volterra integral equation

$$x(t) = a(t) - \int_0^t C(t,s)\left[x(s) + g\big(s, x(s)\big)\right]ds, t \geq 0$$

Under suitable assumptions, we study the existence, the L^1 property, and the asymptotic stability of solution of this equation. For the existence of solution we use the contraction principle, and for the L^1 property we use the Liapunov's method. We obtain these properties directly from the given equation, and then using the associated resolvent equation. We find that there is no advantage using the resolvent equation. Also, we study the asymptotic stability of solution of this equation using the resolvent equation. In this case, we find the resolvent equation is useful.

Exponential Stability and Instability Via Lyapunov Functionals

Wesley Jones

Abstract: We use Lyapunov functionals to obtain exponential stability of the zero solution of functional differential equations. Also, by displaying a suitable Lyapunov functional, we arrive at a criterion for instability.

Modeling volatility: ARCH and GARCH models

Ahlam Alraddadi

Abstract: To assess the performance risk of an asset over time, we estimate its volatility over time. Since the traditional autoregressive moving average (ARMA) models were not feasible to estimate volatility, Engle introduced an autoregressive conditional heteroscedastic (ARCH) model in 1982. The generalized autoregressive conditional heteroscedastic (GARCH) model was later introduced by Bollerslev in 1986. We will introduce both models and discuss their strengths and weaknesses.

Decomposition of complete multipartite graphs into the graph pair of order 4

William Balbach

Abstract: We find necessary and sufficient conditions for the existence of an edge-disjoint decomposition of complete multipartite graphs into the graph-pair of order 4.

Idiosyncratic risks in different regimes and the cross-section of expected stock returns

Ziqi Qiao

Abstract: Grounded in a behavior finance argument, we reexamine the relation between idiosyncratic risks and the cross-section of expected stock returns by taking regime shifts into consideration. Bai-Perron test is applied to test the number of regime shifts and the corresponding break dates. Then, GARCH model is applied to estimate the conditional idiosyncratic risks in each regime obtained. In the end, Fama-MacBeth regression is used to examine the relation between idiosyncratic risks and expected stock returns. We find that regimes do influence the estimation of idiosyncratic risk. By breaking down the regimes, the relations between idiosyncratic risk and stock return vary via regimes; and in some regimes, the relation is insignificant, which is consistent to the fundamental theory of investment. The result supports that investors don't rationally diversify their risks under certain market conditions.

On credit risk- downgrade risk prediction

Danping Wang

Abstract: A brief introduction to the prediction of downgrade probability is given. Using the logistic stepwise method, a decision tree is constructed to find the best regression model. We use this regression model to predict the downgrade probability of the corporate bond for 2006. Then, the model is used to generate a score for each bond for the year 2006. The score is the probability that the bond will downgrade in the year 2007. The decile method is used to compare the actual downgrade rate and the predicted downgrade rate in each decile. We find that 33% downgrades are captured by the first decile.

Constructing Conditional Reference Values for Childhood Skeletal Age and Predicting the Timing of Maturational Spurts

Ramzi W. Nahhas

ABSTRACT: Skeletal maturation, quantified via radiographic assessment of the hand-wrist and estimation of skeletal age, is relevant both clinically and to the study of growth and development. Predicting a child's future skeletal maturational status is often desirable, particularly for children diagnosed with delayed maturation. What is the likelihood that they will catch up to their peers? And over what time span can such "catch-up maturation" be expected? Using serial data from the Fels Longitudinal Study, we used semi-parametric regression to model skeletal age as a function of an earlier skeletal age assessment and the ages of measurement. This model was used to obtain reference values for skeletal age conditional on an earlier assessment for any pair of assessment ages and to compute the probability of an imminent maturational spurt. For those children who were maturationally delayed relative to their chronological age peers, the likelihood of catch-up maturation increased through the average age of onset of puberty and decreased prior to the average age of peak height velocity. For boys, the probability of an imminent maturational spurt was, in general, higher for those who were less mature. For girls aged 10 to 13 years, however, this probability was higher for those who are more mature, potentially indicating the presence of a skeletal maturation plateau between multiple spurts. This model, available for use online, provides a unique tool for predicting future skeletal maturation and maturational spurts, as well as interpreting life history events of modern children.