Spring 2014

2014 (Spring)

University of Dayton. Department of Mathematics

Abstracts of the Colloquium talks: Spring 2014

Date	**Speaker and Title**	**Time/Location**
Thursday, Jan 23	Matthew DeVilbiss, University of Dayton Finding the Grundy Number of line graphs	3:00 PM, SC 323
Thursday, Jan 30	Charlie Suer, University of Louisville Extending the PC-Tree Algorithm to the Torus	3:00 PM, SC 323
Thursday, Feb 6	Paul Eloe, University of Dayton Variation of parameters and fractional difference equations	3:00 PM, SC 323
Thursday, Feb 13	Jonathan Brown, Kansas State University The center of rings associated to directed graphs	3:00 PM, SC 323
Tuesday, Feb 18	Edward Hanson, Williams College Characterization of Leonard Pairs	3:00 PM, SC 323
Thursday, Feb 20	Jean Nganou, University of Oregon A Stone type duality between profinite MV-algebras and multisets	3:00 PM, SC 323
Thursday, Mar 13	Muhammad Islam, University of Dayton Bounded, asymptotically stable and L^1 solutions of Caputo fractional differential equations	3:00 PM, SC 323
Thursday, Mar 20	Paul Eloe, University of Dayton A boundary value problem for a fractional differential equation	3:00 PM, SC 323
Thursday, Mar 27	Tamer Oraby, University of Cincinnati Modeling parental acceptance of vaccination for paediatric infectious diseases	3:00 PM, SC 323
Tuesday, Apr 22	Min Chen, University of Dayton Implementation of A Numerical Scheme for Pricing European Options in Regime-Switching Jump Diffusion Models	3:00 PM, SC 323
Tuesday, Apr 22	Mashael Alshammari and Shahah Almutiri, University of Dayton Exponential Stability In Finite Delay Difference Equations	**3:30 PM, SC 323**
Thursday, Apr 24	Eric Gerwin, University of Dayton An in depth look at random number generation	3:00 PM, SC 323
Friday, Apr 25	Jessica Steve, University of Dayton A comparison of stepwise regression and regression trees for model selection	3:00 PM, SC 323

Finding the Grundy Number of line graphs
Matthew DeVilbiss

Abstract: A Grundy edge-coloring of a graph is a proper (adjacent edges get different colors) assignment of positive integers to the edges of the graph such that if an edge is colored (assigned) $c > 1$, then the edge is adjacent to edges of all the colors $1, \cdots, c_1$. The edge-Grundy number of a graph G(denoted

$\Gamma'(G)$) is the largest positive integer appearing on an edge of the graph, among all the colors appearing on all the Grundy edge-colorings of the graph. The practical significance of this number is its function as an index of a worst possible outcome during online or greedy proper colorings of the graph; such colorings are useful in scheduling. In this work we determine the edge-Grundy numbers of G in a number of cases including the complete graphs, the complete bipartite graphs, the hypercubes, the grids, the regular complete multi-partite graphs, and give bounds on edge-Grundy numbers of some non-regular complete multi-partite graphs.

Extending the PC-Tree Algorithm to the Torus

Charlie Suer

Abstract: Planar graphs have been well studied and there are many linear-time algorithms for determining if a given graph is planar. In particular, The PC-Tree Algorithm of Shih and Hsu (1999) is a practical planarity algorithm that provides a plane embedding of the given graph if it is planar and a Kuratowski subdivision otherwise. The torus and toroidal graphs are less understood, so we discuss extending the PC-Tree Algorithm to a polynomial-time toroidality algorithm. As a proof-of-concept, we show how to accomplish this for \$$K$_{3,3}\$-free graphs. We will also consider connections to other areas such as Graph Minors Theory and the Kuratowski Cover Number. Possible applications of this research in Computer Science and Chemistry will be discussed.

Variation of parameters and fractional difference equations

Paul Eloe

Abstract: We consider a discrete, fractional analogue of the standard ordinary differential equation, $y"(t) - y(t) = f(t)$, and construct a variation of parameters formula to solve the discrete, fractional problem. The talk is self-contained. The variation of parameters technique for ordinary differential equations is revisited and the basic definitions of fractional differences are provided.

The center of rings associated to directed graphs

Jonathan Brown

Abstract: In 2005 Abrams and Aranda Pino began a program studying rings constructed from directed graphs. These rings, called Leavitt Path algebras, generalized the rings without invariant basis number introduced by Leavitt in the 1950's. Leavitt path algebras are the algebraic analogues of the graph $C*$ $-$ algebras and have provided a bridge for communication between ring theorists and operator algebraists. Many of the properties of Leavitt path algebras can be inferred from properties of the graph, and for this reason provide a convenient way to construct examples of algebras with a particular set of attributes. In this talk we will explore how central elements of the algebra can be read from the graph.

Characterizations of Leonard Pairs

Edward Hanson

Abstract: Leonard pairs are pairs of linear transformations that act on each other's eigenspaces in an irreducible tridiagonal fashion. They are related to distance-regular graphs, Lie algebras, and the Askey scheme of orthogonal polynomials. In this talk, we will motivate these connections and discuss some recent characterization results.

A Stone type Duality between profinite MV-algebras and multisets

JEAN B NGANOU

Abstract: MV-algebras were introduced by C. Chang (1958) as the algebraic counterpart of Lukasiewicz many-value logic. MV-algebras play for the Lukasiewicz many-value logic the same role that Boolean algebras play for the two-value logic. Undoubtably, one of the most important theorem on MV-algebras due to Mundici is the equivalence between MV-algebras and Abelian lattice-ordered groups with strong units. The talk will start with the basic definitions, important examples of MValgebras, and a brief description of the equivalence cited above. Profinite algebras are very important objects and understanding these in various categories has proven to be crucial in several important settings. Most likely, the best known examples are in number theory, where the ring of *p*-adic integers can be constructed as the inverse limit of the finite rings $\mathbb{Z}/p^n\mathbb{Z}$. An equally popular example comes from the theory of infinite Galois theory, where the Galois group of infinite Galois extensions can be expressed as inverse limits of finite Galois groups. The main focus of the talk will be presenting my recent results about profinite MV-algebras and their equivalence (of Stone type) to multisets. First, we shall completely characterize the profinite MV-algebras and obtained that they are eaxctly products of finite Lukasiewicz chains. Multisets are defined in combinatorics as pairs $\langle X, \sigma \rangle$, where X is a set and $\sigma : X \to \mathbb{N}$ assigning to each x its multiplicity $\sigma(x)$. The main result is that the category $\mathbb{M}$ of multisets is dually equivalent to the category $\mathbb{P}$ of profinite MV-algebras and homomorphisms that reflect principal maximal ideals.

I will end the talk by describing my ongoing joint work with E. Marra on pro- finitely presented MV-algebras, a significantly more complex class of algebras than profinite ones.

Bounded, asymptotically stable, and solutions of Caputo fractional differential equations

Muhammad Islam

Abstract: The existence of bounded solutions, asymptotically stable solutions, and L^1 solutions of a Caputo fractional differential equation has been studied in this paper. The results are obtained from an equivalent Volterra integral equation which is derived by inverting the fractional differential equation. The kernel function of this integral equation is weakly singular and hence the standard techniques that are normally applied on Volterra integral equations do not apply here. This hurdle is overcome using a resolvent equation and then applying some known properties of the resolvent. In the analysis Schauder's fixed point theorem and Liapunov's method have been employed. The existence of bounded solutions are obtained employing Schauder's theorem, and then it is shown that these solutions are indeed asymptotically stable. Finally, the L^1 properties of solutions are obtained using Liapunov's method.

A boundary value problem for a fractional differential equation

Paul Eloe

Abstract: We will consider a two-point boundary value problem for a Riemann-Liouville type fractional differential equation. The talk is intended as an introduction so definitions and concepts will be given so the talk is self-contained. A particular Banach space is constructed so that wellknown results about positive operators on Banach spaces can be applied.

Modeling parental acceptance of vaccination for paediatric infectious diseases

Tamer Oraby

Abstract: In this talk, I am going to present a mathematical model of vaccine acceptance based on evolutionary game theory and disease modeling in which parents choose between vaccination and non-vaccination strategies by comparing their payoffs which involve perceived probability of infection and risk of vaccination. By incorporating social norms into the model, we found that it better fits pertussis vaccination rate and incidence data of the UK in 1967- 2010, a period that has witnessed the DTP vaccine scare. Contrary to previous models, our model explains the widely observed phenomenon of attaining high levels of vaccine uptake in voluntary vaccination campaigns. Further model analyses and simulations reveal interesting dynamical behaviors of the ODE system depicting the vaccination behavior and disease incidence, e.g. exhibition of bi-stability regions. That bi-stability reveals that, depending on the context, social norms can either support or hinder immunization goals. This talk is based on a joint work with Professor Chris T. Bauch (University of Waterloo) which has recently appeared in Proc. R. Soc. B (2014).

Implementation of A Numerical Scheme for Pricing European Options in Regime Switching Jump Diffusion Models

Min Chen

Abstract: A numerical scheme is implemented and examined in this project for pricing European options in a regime-switching jump diffusion model where the regime-switching is modeled by a continuous-time Markov chain with finite number of states. In this case, European option prices are calculated by numerically solving a system of partial integro-differential equations (PIDEs). We used the numerical scheme to calculate European put prices. Numerical results are reported.

Exponential Stability In Finite Delays Difference Equations

Shaha Almutiri, Mashael Alshammari

Abstract: We use Lyapunov functionals to obtain sufficient conditions that guarantee exponential stability of the zero solution the multiple delays difference equation

$$x(t+1) = a(t)x(t) + \sum_{j=1}^{k} b_j(t)x(t-h_j)$$

The highlight of the paper is relaxing the condition $|a(t)| < 1$. We will provide an example, in which we show that our theorems provide an improvement of some of the recent literature.

An in depth look at random number generation

Eric Gerwin

Abstract: For hundreds of years, random numbers have been an integral part of numerous studies incorporating a variety of disciplines. However, many simply take the idea of “randomness” for granted and fail to take a deep look at the underlying theory. In this paper, we will look at a brief history of random number generation and look at commonly used random number generators. We will study more in depth the most common random number generator, the linear congruential random number generator. From this generator, we will sketch the proof of how to achieve maximum period length through number theory results. We will also list a survey of various tests used for randomness, taking an in depth look at two tests. Using these two tests, we will see how period length affects the randomness of our sequence.

A comparison of Stepwise Regression and Regression Trees for Model Selection

Jessica Steve
Abstract: Regression analysis is a widely known method of statistics used to determine the relationships between two or more variables. Stepwise regression is a common approach for picking predictor variables. However, this method is sometimes known to pick unnecessary variables. Regression trees are an alternative method for choosing predictors. Monte Carlo simulations will be used to compare Stepwise Regression and Regression Trees for selecting predictors. The results of both approaches are compared for both linear and quadratic regression models.