Fall 2011

2011 (Fall)

University of Dayton. Department of Mathematics

Abstracts of the Colloquium Talks: Fall 2011
Department of Mathematics

Date	Speaker and Title	Time/Location
Thursday, Sep 8	Paul Eloe, University of Dayton Gronwall's Inequality on Discrete Fractional Calculus	3:00 PM, SC 323
Thursday, Sep 15	Paul Eloe, University of Dayton A Generalization of Concavity to Higher Order Differential Inequalities	3:00 PM, SC 323
Thursday, Sep 22	Atif Abueida, University of Dayton Equitable Edge Coloring and Cycle Systems	3:00 PM, SC 323
Tuesday, Sep 29	Art Busch, University of Dayton Almost uniquely saturated graphs	3:00 PM, SC 323
Thursday, Oct 13	Dan Zhang, University of Dayton A synthesis of finite difference methods and the jump process arising in the pricing of Contingent Claim	3:00 PM, SC 323
Thursday, Oct 20	Junyao Zhang, University of Dayton A Numerical Algorithm to Value an American Call Option	3:00 PM, SC 323
Thursday, Oct 27	Lynne Yengulalp, University of Dayton Domain representability of function spaces	3:00 PM, SC 323
Thursday, Nov 3	Maher Qumsiyeh, University of Dayton Comparison of Re-Sampling Methods to Generalized Linear Models and Transformations in Factorial and Fractional Factorial Designs	3:00 PM, SC 323
Thursday, Nov 10	Desmond Cummins, University of Illinois Computable Properties of Finitely Generated Decidable Group Presentations	3:00 PM, SC 323
Thursday, Nov 17	Nicholas Haynes, University of Dayton The Quantum Fourier Transform and Consequences for Public-Key Cryptography	3:00 PM, SC 323
Thursday, Dec 1	Chester Lian, University of Dayton Group Theory in Practice: Solving a Rubik's Cube Blindfolded	3:00 PM, SC 323

Gronwall's Inequality on Discrete Fractional Calculus

Paul Eloe

Abstract: We introduce discrete fractional sum equations and inequalities. We obtain the equivalence of an initial value problem for a discrete fractional equation and a discrete fractional sum equation. Then we give an explicit solution to the linear discrete fractional sum equation. This allows us to state and prove an analogue of Gronwall's inequality on discrete fractional calculus. We employ a nabla, or backward difference; we employ the Riemann-Liouville definition of the fractional difference. As a result, we obtain Gronwall's inequality for discrete calculus with the nabla operator. We illustrate our results with an application that gives continuous dependence of solutions of initial value problems on initial conditions.

A Generalization of Concavity to Higher Order Differential Inequalities

Paul Eloe

Abstract Let $u, v \in C^2[a, b]$ and assume $v''(t) \leq 0, a \leq t \leq b$, and $u''(t) = 0, a \leq t \leq b$. Then $v(t) \geq u(t), a \leq t \leq b$. We show a known extension of this concept to higher order differential inequalities and briefly address a family of fixed point applications. We show an alternate extension to higher order differential inequalities and briefly address a family of fixed point applications. The alternate extension represents joint work with recent graduate, Abdulmalik Al Twaty. Currently, the alternate extension is more limited than the known extension.

Equitable Edge Coloring and Cycle Systems

Atif Abueida

Abstract: A k −edge-coloring of a graph G is said to be equitable if for any colors c_i and c_j and a vertex $v \in V(G), |n_v(c_i) - n_v(c_j)| \leq 1$. We discuss the relation between equitable edge coloring and cycle systems.

Almost Uniquely Saturated Graphs

Dr. Arthur Busch

Abstract: The graph G of order n is $H -$ saturated if G contains no copy of , but adding any of the missing edges of G creates a copy of H. The saturation number $sat(n, H)$, is the minimum number of edges needed to construct an H −saturated graph of order n . In this talk, we will discuss how this problem is related to a classical result known as Turan's Theorem and introduce the concept of "uniquely saturated graphs" and "almost uniquely saturated graphs."

A Synthesis of finite difference methods and the jump process arising in the pricing of Contingent Claim

Dan Zhang

Abstract: It is demonstrated that approximation of the solution of the Black-Scholes partial differential equation by using a finite difference method is equivalent to approximating the diffusion process by a jump process and therefore the finite difference approximation is a type of numerical integration. In particular, we establish that the explicit finite difference approximation is equivalent to approximating to diffusion process by a jump process, initially introduced by Cox and Ross, while the implicit finite difference approximation amounts to approximating the diffusion process by a more general type of jump process. This work has been introduced by Brennan and Schwartz, The Journal of Financial and Quantitative Analysis, [13] (1978).

Refreshments will be available at 2:30 in SC 313F

A Numerical Algorithm to Value an American Call Option

Junyao Zhang

Abstract: A numerical algorithm is developed to produce a numerical solution of a boundary value problem for the Black-Scholes partial differential equation on a certain region that includes a free boundary. In this algorithm, an artificial boundary is introduced and a method to find the free boundary

is developed. This algorithm is introduced by H. Han and X. Wu, A Fast Numerical Method for the Black-Scholes Equation of American Option, SIAM J. Numer. Anal., 41 (2003), pp. 2081-2095.

Domain representability of function spaces

Lynne Yengulalp

Abstract: This is a preliminary report of research with Joe Mashburn and Jennifer Hutchison (Cedarville University). I will review some topological completeness properties and review the topology of product spaces and function spaces. One topic that we are investigating is what completeness of a function space can say about the topology of the domain space. Roughly, completeness of a function space may imply strong separation of the domain space. We are interested in two completeness properties in particular, domain representability and weak domain representability.

Comparison of Re-Sampling Methods To Generalized Linear Models and Transformations in Factorial and Fractional Factorial Designs

Maher Qumsiyeh

Abstract Frequently experimental situations occur where the observations are not normally distributed. A common situation occurs when the responses are discrete in nature such as counts. One way to analyze such experiments is to use a transformation for the responses. Another is to use a link function based on a generalized linear model approach. In this pwork , re-sampling is used as an alternative method to analyze such data. The results will be compared with those provided by the previous two methods.

Note: This is a joint work with Gerald Shaughnessy.

Computable Properties of Finitely Generated Decidable Group Presentations

Desmond Cummins

Abstract: For a finitely generated group presentation P, the three following questions are of interest. Is the word problem solvable for P? Is the bounded word problem solvable for P? Finally, is the Dehn function of P computable? It is straightforward to show that there does not exist a decidable finitely generated presentation for which the word problem is solvable, the bounded word problem is solvable, and the Dehn function is not computable. Similarly, there is no decidable finitely generated presentation for which the word problem is unsolvable, the bounded word problem is solvable, and the Dehn function is computable. We will show that examples exist of finitely generated decidable minimal group presentations that satisfy every remaining combination of solvability/unsolvability for these three questions. The construction of these examples relies on machinery developed by Birget, Rips, and Sapir to construct group presentations that “simulate" Turing machines.

The Quantum Fourier Transform and Consequences for Public-Key Cryptography

Nicholas Haynes

Abstract: In 1994, Peter Shor developed a quantum algorithm for evaluating the discrete Fourier transform (DFT) requiring $0(n^2)$ steps, as opposed to the $0(n2^n)$ steps required for the classical DFT. Though several quantum algorithms offering modest speedups already existed, the quantum Fourier transform (QFT) was the first example of an algorithm designed for a quantum computer requiring exponentially fewer steps than its best known classical counterpart. A direct result of the QFT is the

ability to easily find the prime factors of a large number, a problem which is considered hard for a classical computer. The problem of prime factorization is the basis of many public-key encryption schemes currently in use, making the prospect of a sufficiently large-scale quantum computer a threat to much of today's internet security.

We will review the basics of quantum computation before deriving Shor's algorithm in detail. Time permitting, we will also demonstrate how a quantum communications network can offer cryptographic security that is, in principle, unbreakable.

Group Theory in Practice: Solving a Rubik's Cube Blindfolded

Chester Lian

Abstract: We present one view of the mathematics behind this classic puzzle and the theory behind a popular method for solving it blindfolded. We also discuss several optimizations for human solvers used in practice.