Spring 2016

2016 (Spring)

University of Dayton. Department of Mathematics

Generalized Trigonometric functions and bases in L^p space

Jan Lang

The Ohio State University

Abstract: Generalized trigonometric functions $\sin_p$ and $\cos_p$ generalize the familiar trigonometric functions and coincide with them when $p = 2$. These functions, which are related to eigenfunctions of p-Laplacian, have many similarities to their classical counterparts but also differences. We will show that they play an important part in the theory of the p-Laplacian, Theory of Approximation and Theory of Integral operators. Particular attention is paid to the basis properties of the sequences generated by generalized trigonometric functions in the context of Lebesgue spaces.

Novel techniques for integrating over implicitly defined curves and surfaces

Catherine Kublik

University of Dayton

Abstract: We describe formulations for integrating over smooth curves and surfaces that are described through a level set function or directly by their closest point mapping. Contrary to the common practice with level set methods, the volume integrands derived from our formulations coincide exactly with the surface or line integrals that one wishes to compute. With these formulations, one can solve elliptic boundary value problems on implicitly defined domains using integral equations. We present numerical results in two and three dimensions and a possible generalization to include surfaces with corners and edges. (Joint work with Richard Tsai from UT Austin and KTH Royal Institute of Technology)

Introduction to topological games

Lynne Yengulalp

University of Dayton

Abstract. Topological completeness properties can be formulated in terms of topological games. This talk will be an introduction to 2-player topological games with infinitely many rounds and the completeness properties that they describe.

Instantons and Open Spaces

Andres Larrain-Hubach

University of Arizona

Abstract: In this talk, based on current work with Sergey Cherkis and Mark Stern, I will review the theory of instantons on open manifolds. Instantons are generalizations of harmonic functions and their study is important in mathematical physics and geometry. I will review basic definitions and, at the end, mention some new new results concerning instanton asymptotics.

Synthetic geometry and the isometric embedding problem

Barry Minemyer

The Ohio State University

Abstract: In the first half of this talk we will discuss how to determine the geometry of a "flat n-dimensional triangle" given only the lengths of the edges of that triangle. In the second half of the talk we will then show how this synthetic formula helped develop combinatorial analogues to the famous Nash isometric embedding theorems.

Nilpotent groups and their linear representations

Caleb Eckhardt

Miami University

Abstract: Most countable groups resist a satisfying representation theory. This is in contrast with the situation for Lie groups where many Lie groups admit a satisfying representation theory. We'll define "satisfying." We then discuss how--even when a satisfying representation theory is impossible--we use recent progress in the theory of C*-algebras to classify the C*-algebras (i.e. rings generated by the linearization of a group representation) generated by irreducible representations of nilpotent groups. No familiarity with nilpotent groups, representation theory or C*-algebras will be assumed.

Stability of non-unique solutions of differential equations

Muhammad Islam

University of Dayton

Abstract. We consider an initial value problem (I. V. P.) of a first order nonlinear ordinary differential equations. We assume that the I. V. P. can have more than one solution. We study a new type of stability property of these solutions. This stability is not the standard Liapunov stability, commonly studied in the field of differential equations.

Bounds on the cardinality of a topological space

Nathan Carlson

California Lutheran University

Abstract: Cardinality bounds on topological spaces have a long and storied history and are very much an active area of research in set-theoretic topology today. A major breakthrough came in 1969 when A.V. Arhangel'skii introduced a fundamentally new technique to establish that the cardinality of a compact, first-countable, Hausdorff space is at most the cardinality of the reals. This answered a question that had been open for 50 years prior. Bounds on topological spaces are expressed in terms of "cardinal invariants"; i.e. cardinal-valued functions that measure a certain property of a space. One such cardinal invariant is the weight of a space, which is the least cardinality of a basis. Another is the density, which is the least cardinality of a dense subset. In this talk we will begin with a little set-theoretic background, survey several important cardinal invariants, and present a few basic cardinality bounds. We will also explore the deeper results of Arhangel'skii and Hajnal-Juhász. Finally, many bounds can be improved if the space is known to be topologically homogeneous; that is, for every pair of points in the space there is an autohomeomorphsim of the space that maps one point to the other. In a homogeneous space, the topology at every point is "identical" to the topology at any other point. In 1978, Erik van Douwen established the first known cardinality bound for homogeneous, Hausdorff spaces. We will give a survey a few results of the speaker in this connection.

Analyzing Low Birth Weights using Logistic Regression

Brandon Thornton

University of Dayton

Abstract: Logistic Regression is modeling data when the dependent variable is categorical. When the data is binary in nature (success or failure) then the model is a Binary Logistic model. This research highlights the theory of Logistic Regression pertaining to model creation, parameter estimation, hypothesis testing, and more. In an applied analysis, Logistic Regression is used to develop a model identifying the risk factors causing low weight births of infants which can severely impact their health.

On the perfect reconstruction of the structure of dynamic networks

Alan Veliz-Cuba

University of Dayton

Abstract: The network inference problem consists in reconstructing the structure or wiring diagram of a dynamic network from time-series data. Even though this problem has been studied in the past, there is no algorithm that guarantees perfect reconstruction of the structure of a dynamic network. In this talk I will present a framework and algorithm to solve the network inference problem for discrete-time networks that, given enough data, is guaranteed to reconstruct the structure with zero errors. The framework uses tools from algebraic geometry.

Lyapunov Functionals and Stability in Nonlinear Infinite Delay Volterra Discrete Systems

Abstract

In this research, we utilize Lyapunov functionals and obtain sufficient conditions for the stability of the zero solution of the discrete Volterra system of the form

$$x(t+1) = Px(t) + \sum_{s=-\infty}^{t-1} C(t,s)g(x(s)).$$

Due to the nature of the Lyapunov functional, we will be able to show that all solutions are $l\big([t_0,\infty)\cap\mathbb{Z}\big)$.

The Non-Classical Linear Boltzmann Equation and Applications to Particle Transport

Richard Vasques, University of California, Berkeley

Abstract: How is sunlight passing through clouds related to a nuclear reactor? Can we improve medical imaging by understanding the behavior of sharks? This talk starts with a quick overview of kinetic descriptions of physical phenomena, and then focuses on some of the latest developments in the modeling of subatomic particles interacting with a homogenized random background medium. We introduce the audience to the standard Boltzmann Transport Equation, explaining the general physical processes described by each of its terms. We then pose the problem of modeling transport in a stochastic medium motivated by some important applications in the fields of nuclear medicine, atmospheric sciences, and reactor physics. We describe a novel model that uses a Non-Classical approach to particle transport, and present some results to nuclear engineering applications.

The Effect Of Executive Compensation and revenue Diversification on Bank Insolvency Risk

Jia Song

Abstract: This paper investigates the effect of executive compensation and revenue diversification on bank risks from 1992 to 2010 including 1465 bank-year observations using Cox proportional hazard model. Vega is used to measure the effect of executive compensation on insolvency risk, and non-interest income is used to measure the effect of revenue diversification. The result came out that both vega and non-interest income can help to reduce bank insolvency risk. In addition, when non-interest income is further divided into trading revenue and non-trading revenue component, the result shows that they are all negatively related to bank insolvency risk.

A Numerical Study of a Mathematical Model of Cell Growth in Scaffolds

James Stewart
Advisor: Dr. Muhammad Usman

Abstract: In this work we consider a mathematical model of cell growth in scaffolds for tissue regeneration. This model is taken from the work by Darae Jeong, Any Yum and Junseok Kim. We present numerical solutions of a system of partial differential equations. We solve the system numerically using finite difference schemes including a multigrid method coupled with a second order Runge-Kutta method. The algorithms will be run and tested through a series of computer simulations that will determine the accuracy and efficiency of the finite difference method.

An Optimal Consumption and Investment Problem with CIR Model

Wenyan Lu
Advisor: Dr. Dan Ren

Abstract: This paper solves an optimal consumption and investment problem when the interest rate follows a Cox-Ingersoll-Ross (CIR) model. This is an extension of [Guasoni, Huberman, Ren], in which the model is constructed with shortfall aversion but constant risk-free rate. In particular, the CIR model is employed to estimate risk-free rate in two different ways: 1) apply the CIR model to the entire time period and estimate the risk-free rate by a single constant; 2) create a sequence of risk-free rates by applying the CIR model to the time period up to each time. Compared to the "NO CIR" model, our new optimal problem gives better results by applying the CIR model in both ways described above. Furthermore, the result of the first way is better than the result of the second way because more information is used to estimate the risk-free rate in the first way.