Fall 2009

# 2009 (Fall)

University of Dayton. Department of Mathematics

**Abstracts of the Colloquium Talks: Fall 2009**
**Department of Mathematics**

| Date | Speaker and Title | Time/Location |
|---|---|---|
| Thursday, Sep 10 | Murat Adivar, Izmir University of Economics<br>Function Bounds for Solutions of Volterra Integro Dynamic Equations on Time Scales | 3:00 PM, SC 323 |
| Thursday, Sep 17 | Lynne Yengulalp, University of Dayton<br>Non-normality points of the Stone-Cech remainder | 3:00 PM, SC 323 |
| Thursday, Sep 24 | Lynne Yengulalp, University of Dayton<br>Non-normality points of the Stone-Cech remainder | 3:00 PM, SC 323 |
| Thursday, Oct 1 | Elizabeth Zollinger, Hiram College<br>A family of comets in the 3-body problem | 3:00 PM, SC 323 |
| **Tuesday, Oct 13** | Elham Negahdary, University of Dayton<br>An Efficient Radial Basis Function Approach to Lax and Sawada-Kotera Equations | 3:00 PM, SC 323 |
| Thursday, Nov 5 | Qian Li, University of Dayton<br>The Economic Dynamics of Financial Crisis | 3:00 PM, SC 323 |
| Thursday, Nov 12 | Sri Krishna Chirumamilla, University of Dayton<br>Boundary Layer Phenomena and Perturbation Methods in Non-Homogeneous Differential Equations | 3:00 PM, SC 323 |
| Thursday, Nov 19 | TaraLee Mecham, College of Mount St. Joseph<br>Largeness of Graphs of Abelian Groups | 3:00 PM, SC 323 |
| Thursday, Dec 3 | Ashley Yontz, University of Dayton<br>Using Data Envelopment Analysis (DEA) to Measure the Efficiencies of Pharmaceutical Preparation Companies | 3:00 PM, SC 323 |
| Thursday, Dec 10 | Thomas Wakefield, Youngstown State University<br>On Characters, Character Degrees, and a Conjecture by Huppert | 3:00 PM, SC 323 |

**Function Bounds for Solutions of Volterra Integro Dynamic Equations on Time Scales**

Murat Adıvar

**Abstract:** Introducing shift operators δ± on time scales we construct the integro dynamic equation

$$x^{\Delta(t)} = -a(t)x(t) + \int_{t0}^{t} b\left(\delta_{(s,t)}\right)x(s)\Delta s,\ \ t \in [t_0, \infty)_{\mathbb{T}}$$

which includes the following Volterra equations in particular cases:

- *Volterra integro differential equation of convolution type:* For $\mathbb{T} = \mathbb{R}$ with $\delta\_(s,t) = t - s$ and $t_0 = 0$

$$x'(t) = -a(t)x(t) + \int_0^t b(t-s)x(s)ds,\ t \in [0,\infty).$$

- *Volterra integral equation with fractional kernel:* For $\mathbb{T} = \mathbb{R}$ with $\delta\_(s,t)$ = *t/s* and $t_0 = 1$

$$x'(t) = -a(t)x(t) + \int_1^t b\left(\frac{t}{s}\right) x(s)ds, \qquad t \in [1, \infty)$$

- *Volterra integro difference equation of convolution type:* For $\mathbb{T} = \mathbb{Z}$ with $\delta\_(s,t) = t - s + \lambda$ and $t_0 = \lambda$

$$\Delta x(t) = -a(t)x(t) + \sum_{k=\lambda}^{t-1} b\ (t - k + \lambda)x(k), t \in [\lambda, \infty) \cap \mathbb{Z}+,$$

Extending the scope of time scale variant of Gronwall's inequality we determine function bounds for the solutions of integro dynamic equation. Providing numerical examples we illustrate efficiency of obtained results. Moreover, we propose sufficient conditions implying exponential asymptotic stability of the trivial solution.

**Non-normality points of $\boldsymbol{\beta X \setminus X}$ (Stone-Cech remainder)**

Lynne Yengulalp

**Abstract:** A topological space $Y$ is called normal if every pair of disjoint closed subsets of $Y$ can be separated by a pair of open subsets of $Y$. Normality is not a hereditary property. That is, if $Y$ is normal and $Z$ is a subspace of $Y$, it is not necessarily the case that $Z$ is normal. If $Y$ $i$s normal and an element $y$ of $Y$ is such that the subspace $Z = Y \setminus \{y\}$ is not normal, $y$ is called a non-normality point of $Y$. The Stone-Cech compactification of a Tychonoff space $X$, denoted $\beta X$, is the largest compacti- fication of $X$. We discuss non-normality points of $\beta X \setminus X$ when $X$ is a discrete space or, more generally, a locally compact metric space.

**A family of comets in the 3-body problem**

Elizabeth Zollinger

**Abstract:** We will consider the Newtonian three-body problem with equal masses. In particular, we will look at the family of curves that have collinear initial position and, after a given time, end up in an isosceles configuration with a fixed amount of rotation. For small angles of rotation, we obtain the classic comet orbit whose existence has historically relied on a limiting argument. Using variational arguments, which are more global in nature than limiting arguments, we find a family of periodic orbits extending from the extreme "comet'' case to orbits in which the ``comet'' passes close to both primaries. All of these orbits have the same topology and they can be deformed into one another without passing through collision, which will be illustrated on the shape sphere.

**An Efficient Radial Basis Function Approach to Lax and Sawada- Kotera Equations**

Elham Negahdary

**ABSTRACT** In this paper we present a numerical solution of a family of generalized fifth-order Korteweg-de Vries equations using a meshless method of lines. This method uses radial basis functions for spatial derivatives and Runge-Kutta method as a time integrator. This method exhibits high accuracy as seen from the comparison with the exact solutions.

**The Economic Dynamics of Financial Crisis**

Qian Li

**Abstract:** The current financial crisis comes from the subprime mortgage woos that occurred in the USA in 2007. Beginning with the failures of large financial institutions in the United States, it rapidly propagated into a global financial and economic crisis. Since the impact of financial crisis on the global

economy is dramatic and wide spread, conducting research on the economic dynamics of financial crisis helps us to trace the root of financial crisis. This research studies the economic dynamics of financial crisis, the contagion of economic shocks, and how economic shocks interact with each other during the crisis period. Economic shocks include shocks in the stock market, housing market, credit market, and commodity market. Empirical evidences are examined at both the aggregate (macro) and individual firm (micro) level. At the macro level, we set up a VAR system in which the interactions of shocks in the stock market, housing market, credit market, and commodity market are examined. Variance decomposition and impulse response analyses offer us better understanding about the path of such shocks and the dynamics that economic system returns to equilibrium. At the micro level, quantile regression models are conducted on a cross-section of stocks to analyze the impact of economic shocks on stock market performance. Quantile regression examines the different responses of equity returns to financial crisis at the tails of the return distribution, and allows us to find factors contribute to good/bad performance during the crisis period.

**Boundary Layer Phenomena and Perturbation Methods in Non-homogeneous Differential Equations**

Sri Krishna K. Chirumamilla

**Abstract** In this research, we discuss boundary layers in non-homogeneous second order differential equations of the form

$$\epsilon y'' + p(t)y' + q(t)y = f(t), 0 < t < 1, 0 < \epsilon << 1$$
$$y(0) = \alpha, y(1) = \beta, p(t) > 0, p(t) < 0.$$

Boundary layers occur in differential equations in which the perturbations are operative over very narrow regions across which the dependent variables undergo very rapid changes. These narrow regions frequently adjoin the boundaries of the domain of interest owing to the fact that the small parameter multiplies the highest derivative in the differential equation. Consequently, they are referred to as boundary layers in fluid mechanics, edge layers in solid mechanics, and skin layers in electrical applications. There are many physical situations in which the sharp changes occur inside the domain of interest, and the narrow regions across which these changes take place are usually referred to as shock layer in fluid and solid mechanics, transition points in quantum mechanics, and Stokes lines and surfaces in mathematics. These rapid changes cannot be handled by slow scales, but they can be handled by fast or magnitude or stretched scales.

**Largeness of Graphs of Abelian Groups**

TaraLee Mecham

**Abstract:** A group is called large if it can be mapped onto a non-abelian free group. Large groups have many interesting properties including super exponential subgroup growth and infinite virtual first Betti-numbers. We will look at groups that arise from free products with amalgamation and HNN-extensions of classes of abelian groups and determine when such groups are large.

**About the speaker:** Tara was born and raised in Idaho and received a BA in Mathematics and Mathematics Education from Boise State University in 1995. After teaching in the US and Japan for several years she received her PhD in Mathematics from the University of Oklahoma in 2009. Her major field of study is Geometric Group Theory. She is currently an Assistant Professor at the College of Mount Saint Joseph. Tara's hobbies and interests include the Japanese language, contemplating the irrationality of the BCS, cooking, crafts and needlework (she has crocheted several Mobius band bookmarks and scarves), and singing opera and art songs.

Refreshments at 2:30 PM in Science Center 313
Talk at 3:00 PM in Science Center 323

**Using Data Envelopment Analysis (DEA) to Measure the Efficiencies of Pharmaceutical Preparation Companies**
Ashley Yontz
**Abstract:** This presentation is a discussion regarding the technical and scale efficiencies of 37 pharmaceutical companies for each year 2001-2006 using data envelopment analysis (DEA) based on multiple inputs and a single output. The industry data was obtained through the CompuStat Industry Files database. Comparisons of the relative efficiencies of the companies are made. Several financial ratios were computed for each company with the interest of detecting the correlation between a company's scale efficiency and their financial ratios for each year. At the conclusion of the study, key points in the outlook of the pharmaceutical industry will be discussed.

**On Characters, Character Degrees, and a Conjecture by Huppert**
Thomas Wakefield
**Abstract:** In the late 1990s, Bertram Huppert conjectured that if G is a finite group and H a finite nonabelian simple group such that the sets of character degrees of G and H are the same, then G is the direct product of H and an abelian group. We will define and examine the major results in character theory with the goal of discussing Huppert's Conjecture and the progress towards its verification.

About the speaker: Tom Wakefield is an Assistant Professor in the Department of Mathematics and Statistics at Youngstown State University. He received his Ph.D in pure mathematics from Kent State University in August 2008 and spent a year teaching at Slippery Rock University of Pennsylvania. His research interests include the representation theory of simple groups, particularly with regards to character theory. He is also interested in actuarial science and applications of mathematics to finance and economics.

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