Graduate Student Paper Session
NES/MAA Fall 2005 Meeting, University of New Hampshire

Session I

9:00 – 9:15 am - Group Gradings Of Matrix Algebras And Incidence Algebras
Lance Miller, University of Connecticut

Graded rings and algebras are a ubiquitous object in the study of projective algebraic geometry. A slight generalization of this notion is that of a group grading; group gradings of matrix algebras have recently been well-developed. In this talk we will present an accessible introduction to these objects and some highlights of the current research into group gradings of matrix algebras and subalgebras of matrix algebras (specifically incidence algebras or structured matrix algebras).

9:17 – 9:32 am - A Night at the Operads
Rachel Schwell, University of Connecticut

Mathematical operads are tools that describe an algebraic structure that can be attached to many different sets. We will define operads and algebras over operads, and demonstrate them through accessible examples, namely real-valued functions and trees. We will then introduce a set of polyhedra whose faces are given by the different associations one can insert in an n-letter multiplication, called Stasheff polyhedra or associahedra. We will conclude with a nice theorem that links these polyhedra to based loop spaces. Further applications of operads can be found in algebraic topology, representation theory, algebraic geometry, combinatorics, knot theory, quantum physics, and string theory.

9:34 – 9:49 am - Decoherence in quantum walks on the hypercube
Gorjan Alagic, University of Connecticut

Recent research in quantum computation has led to the development of natural quantum analogues of the classical random walk. This area of research has already met with significant success, in particular by producing a quantum walk algorithm for an oracle problem, which performs exponentially better than is possible classically. In this talk, we will discuss the continuous quantum walk on a graph, as well as recent results (joint work with Alexander Russell) about the effects of decoherence on the quantum walk on the hypercube. Since any real quantum system suffers from decoherence, this is a matter of significant importance for any practical implementation.

Session II

9:00 – 9:15 am - Ill-posed Problems and Regularization Methods
Malena Espanol, Tufts University

Discrete ill-posed problems in the form of linear systems or least squares problems occur in a variety of applications, for example in image deblurring. The difficulty in solving discrete ill-posed problems is the presence of noise on the right hand side of the linear system. The ill-posed nature of the problem ensures that the least squares solution will not approximate its true solution. In this talk we discuss properties of discrete ill-posed problems and give an introduction to numerical techniques for approximating a regularize solution of it. We present a new regularization algorithm, and show promising numerical results.

9:17 – 9:32 am - Stability of Solutions to the Discrete Nonlinear Schrödinger Equation in Multiple Dimensions
Jacob A Gagnon, University of Massachusetts - Amherst

The Discrete Nonlinear Schrödinger (DNLS) equation has generated much mathematical interest in recent years due to its wide variety of physical applications. Bose Einstein condensates, optical waveguides, and photonic lattices are just a few examples of its applications. In this talk, I will present solutions to the time periodic DNLS using finite differencing in one, two, and three spatial dimensions. The stability of these solutions to small perturbations has been studied and the parameter values yielding stable solutions have been identified. Lastly, I will discuss my current work in determining the time evolution of unstable solutions.

9:34 – 9:49 am - Generalized Pythagorean Tuples
Lisa Henkel, New Hampshire

A Pythagorean Triple is a triple of integers (x, y, z) such that $x^2 + y^2 = z^2$. Hadwin & Teigen had a method of generating Pythagorean triples that can be generated by a matrix transformation. H. Anders Lonnemo created a matrix L that maps Pythagorean triples to other Pythagorean triples. Starting with the triples (1, 0, 1) and (0, 1, 1), all the Pythagorean triples can be generated by the application of L and the matrices formed by negating a coordinate of (x, y, z). In this talk we extend Lonnemo's result by looking at 4-tuples (w, x, y, z).

Session III

9:00 – 9:15 am - Uniqueness For The Martingale Problem Associated With Some Partial Differential Operators
Huili Tang, University of Connecticut

The motivation of the martingale problem as well as the relation between martingale problem and Stochastic Differential Equations will be introduced. Some results of uniqueness will be presented.

9:17 – 9:32 am - New Approaches In Stochastic Calculus Of Non-Adapted Processes
Kaveh Fouladgar, Brown University

In many problems in physics, economics and … is mostly dealt with non-adapted processes, so after the definition of Skorhod integration in terms of Wiener- Ito chaos expansion and the analogous differentiation by Malliavin, studying stochastic calculus in terms of these new operations has become an interesting subject for research. The key point in any reasonable calculus is a formula similar to chain rule which enables us to calculate of derivative of complicated functions in terms of their building blocks, finding this formulas which are called the Ito formulas is generally very hard and complicated, but in Voltera process is happens that we can find a nice representation by using Skorhod integral, Maliavin derivative and translation of the Gaussain process to a Skorhod integral. In a special case the formulation can be given explicitly for fractional Brownian motion.