

Archived Seminars

2013/14

September 11, 2013, 9:10am: Oscar Vega (CSUF)

Title: *On a Conjecture About Packings of Subspaces, (Part I)*

Abstract: Let V be a 4-dimensional vector space over a finite field of order q . A spread of V is a collection of 2-dimensional subspaces of V that cover the set of vectors in V , and that have trivial pairwise intersection. A partition of the set of all 2-dimensional subspaces of V into (disjoint) spreads is said to be a packing of V .

Several interesting questions may be posed about packings: Do they always exist? Do they admit automorphism groups? Can we construct a packing from a fixed spread and a suitable group? Can we construct new packings out of known ones? We are interested on these questions and on an old conjecture regarding “incomplete” packings and when, and how, they can be completed.

In these talks we will present an algebraic approach to this conjecture, that we hope will eventually yield some light on this issue. Several preliminary results will be given. Students are encouraged to attend these talks. Most ideas used will be combinatorial (MATH 114) and geometric (MATH 161). Most tools used will be from Linear Algebra (MATH 152) or Abstract Algebra (MATH 151). Any student who has taken either of these classes should be able to get a good grasp of what we will be discussing.

September 18, 2013, 9:10am: Oscar Vega (CSUF)

Title: *On a Conjecture About Packings of Subspaces, (Part II)*

Abstract: See September 11, 2013 Seminar.

October 2, 2013, 9:10am: Carmen Caprau (CSUF)

Title: *Knot-theoretic Interactions and Matrix Algebra*

Abstract: The Yang-Baxter equation (YBE) was first introduced in statistical mechanics, and a whole industry developed of finding solutions to the YBE, which eventually lead to the discovery of quantum groups. The Yang-Baxter equation also shows up in knot theory, as one can define invariants for knots using certain solutions to the YBE.

In this talk, I will introduce the Yang-Baxter equation and some of its applications to knot theory. Along the way, we will interpret a knot diagram as an abstract tensor diagram. This is a diagrammatic version of matrix algebra where the matrices have many indices. In addition, I will explain how solutions to the YBE are directly related to invariants for knots. Students are encouraged to attend; as a useful background, one only needs some knowledge of matrix algebra and group theory.

October 9, 2013, 9:10am: Carmen Caprau (CSUF)

Title: *The Kauffman Bracket via a Solution to the Yang-Baxter Equation*

Abstract: The Yang-Baxter equation (YBE), first introduced in statistical mechanics, shows up in knot theory via state models for invariants of knots and links, based on solutions to the YBE. The Kauffman bracket is a polynomial invariant for unoriented knots, and is combinatorially defined using the theory of skein relations for knot diagrams. In this talk I will give a version of the Kauffman bracket based on a certain solution to the YBE. If time allows, I will explain how to extend this approach to invariants of other knot-like objects.

Students are encouraged to attend; as a useful background, one only needs some knowledge of matrix algebra and group theory.

December 4, 2013, 9:10am: Lance Burger (CSUF)

Title: *An Introduction to Cramer's Paradox*

Abstract: Gabriel Cramer and Leonhard Euler both wrote important books on the theory of equations in the mid 18th century. During the years leading up to their publication, they carried on a friendly and fruitful correspondence. One topic they discussed was a paradox that was first noticed by Maclaurin: that nine points should be sufficient to determine a curve of order three, and yet two different curves of order three could intersect in up to nine different places. Although this situation has come to be known as Cramer's Paradox, it was Euler who first suggested the resolution of this apparent contradiction in a letter that was lost long ago but rediscovered in the Smithsonian Institute in 2003. In this talk, we investigate the properties of algebraic curves of order two and higher and describe Cramer's Paradox and Euler's resolution, including his elegant example of an infinite family of cubic curves that all pass through the same nine points.

December 10, 2013, 2:00pm: Elda Bautista (Fresno State graduate student)

Title: *Preconditioned Multigrid*

Abstract: The elliptic partial differential equations (PDEs) generate large, sparse linear systems of equations. There exists the need for an efficient and robust numerical methods for solving these PDEs with very few iterations. The size problem will increase as hardware constraints allow it, so we need to develop a method whose convergence is independent of the number of unknowns. Multigrid is characterized for this and for its rapid convergence and less storage memory than other iterative methods. The power of multigrid methods resides in the combination of a simple iterative method, such as the Gauss-Seidel method, and prolongation and restriction schemes. However, multigrid methods are problem oriented and do not always converge in few iterations. We are incorporating the robustness of the preconditioners with the power of the multigrid methods. First, we examine the formulation of multigrid methods, multigrid as preconditioner of a projection method (GMRES), and preconditioned multigrid. Then, we compare the performance of the multigrid, multigrid

preconditioned GMRES and the preconditioned multigrid methods using three well known preconditioners: PSSOR, ILU(0), and AINV in numerical examples.

December 11, 2013, 9:10am: Marat Markin (CSUF)

Title: *A Gelfand Type Theorem for Normed Algebras*

Abstract: In the course of our end-of-semester discussion, we are going to prove a Gelfand type theorem giving a characterization of one-dimensional normed algebras. A short lucid proof of this statement resting upon basic principles of linear algebra and analysis demonstrates a powerful interplay between the latter unhindered by unnecessary sophistication.

January 30, 2014. 10:30am: Xizhen Cai (Pennsylvania State University)

Title: *Variable Selection for the Proportional Odds Model*

Abstract: In the initial stage of a statistical modeling procedure, many predictors are included in the model to reduce potential model bias. However, this may increase computational cost and create problems like multi-collinearity. Variable selection is needed to fit the model consistently and parsimoniously at the same time. To overcome the drawback of some classical variable selection methods, penalized likelihood approaches have been used for generalized linear models in recent years, and the corresponding estimates enjoy an oracle property (Fan and Li, 2001). In this talk, I will discuss the problem of variable selection for the proportional odds model, which is a survival model for censored data. Since it is a semi-parametric model, the penalized profile likelihood is maximized to estimate parameters and select variables simultaneously. Under certain regularity conditions, the estimates for nonzero coefficients are proved to be normally distributed while those for zero coefficients are zero with probability going to one. These results are derived by an expansion for the profile likelihood function by Murphy and Van der Vaart (2000), and can be easily generalized to a much broader range of semi-parametric models. In addition, algorithms to maximize the penalized likelihood are proposed based on a majorization-minimization (MM) algorithm. Tests on simulated and real data sets demonstrate that the newly proposed algorithms perform well in practice.

February 5, 2014. 9:30am: Xueli Liu (Division of Biostatistics, City of Hope)

Title: *Identifying Temporally Differentially Expressed Genes Through Functional Principal Component Analysis*

Abstract: Temporal gene microarray is an important tool to identify genes with differential expressions over time. Traditional analysis of variance (ANOVA) type of longitudinal investigation may not be applicable because of irregular time intervals and possible missingness due to contamination in microarray experiments. In this talk, we propose a functional principal component analysis approach to test hypotheses in the change of the mean curves

under two conditions. A permutation test under a mild assumption is used to make the method more robust. The proposed method outperforms the recently developed extraction of differential gene expression and a two-way mixed effects ANOVA under reasonable gene expression models in simulation. Real data on transcriptional profiles of blood cells microarray from treated and untreated individuals were used to illustrate the method. This is a joint work with Dr. Mark Yang.

February 14, 2014. 10:00am: Shanshan Ding (University of Minnesota)

Title: *Envelopes for Matrix-valued Regressions*

Abstract: Envelopes (Cook et al., 2010) were originally proposed for multivariate regression analysis to achieve potential efficiency gains. In this talk, I will introduce envelope models for efficient estimation in matrix-variate analysis, where the response Y is a random matrix and the predictor X can be either a scalar, or a vector, or a matrix, treated as non-stochastic. The matrix-variate regression models and their envelope structures are generalizations of conventional regressions and their envelopes. They can be applied to neuroimaging, cross-over design analysis, economics, and multivariate growth curve modeling, among others. Under the envelope framework, immaterial information can be eliminated in estimation and the number of parameters can be notably reduced when the matrix-variate dimension is large. Therefore, the estimation can be much more accurate and efficient. We further investigate the asymptotic properties of the envelope estimators and show their efficiency in both theoretical and numerical studies.

March 19, 2014. 10:00am: Pallavi Sawant (Auburn University)

Title: *Robust Functional Principal Component Analysis*

Abstract: Functional principal component analysis is the preliminary step to represent the data in a lower dimensional space and to capture the main modes of variability of the data by means of small number of components which are linear combinations of original variables. Sensitivity of the variance and the covariance functions to irregular observations make this method vulnerable to outliers and may not capture the variation of the regular observations. In this work a robust functional principal component analysis is proposed to find the linear combinations of the original variables that contain most of the information in presence of outliers and to flag functional outliers. Results from simulation study and a real world example demonstrate the performance of the proposed method.

March 20, 2014. 10:00am: Steve Chung (Florida State University)

Title: *A Class of Semiparametric Multiplicative Volatility Models Using Bernstein Polynomials with Applications to Exchange Rates*

Abstract: In situation where predicting the volatility of returns is the main goal, gener-

alized autoregressive conditional heteroskedasticity (GARCH) specification is widespread in applications, especially the standard GARCH(1,1). The GARCH models have been extensively studied and well documented in financial and econometric literature. Despite their popularity, they suffer from model flexibility. To ease the strict structural assumptions, we propose a class of semiparametric multiplicative volatility models where the parametric part is estimated from GARCH(1,1) and the nonparametric part is constructed from a sieve of Bernstein basis polynomials. The model is estimated from an iterative algorithm based on boosting with the square error function. Our semiparametric multiplicative volatility model is evaluated using simulations and applied to the six major exchange rates. The results show that the proposed model outperforms the existing volatility models in both in-sample estimation and out-of-sample prediction.

April 3, 2014. 12:00pm: Oscar Vega (CSUF)

Title: *α -Flokki*

Abstract: α -flokki generalize the well-studied, and well-known, flocks of quadratic cones. They were introduced in 2009 by Kantor and Penttila, and later on studied by Cherowitzo and Johnson (2010), and Cherowitzo and Holder (unpublished).

In this talk the speaker will explain how α -flokki generalize flocks of quadratic cones, and also go over the interesting connections between α -flokki and certain translation planes. The structure of the collineation group of such planes will also be discussed.

Most of the results in this talk are in an article authored by W. Cherowitzo (UC Denver), N.L. Johnson (U of Iowa), and the speaker. Part of this article was written while the speaker was in a sabbatical leave (and visiting UC Denver). Hence, this talk constitutes his sabbatical leave oral report.

April 25, 2014. 10:00am: Carmen Caprau (CSUF)

Title: *Quantum invariants for knot-like objects*

Abstract: Quantum invariants for knots and links play a central role in knot theory and its ramifications. In recent years, there has been a great interest in the study of knot-like objects, including singular links, knotted graphs, and virtual knots. A knotted graph is an embedding of a graph in the three-dimensional space, and a singular link is an immersion of a disjoint union of circles into the three-dimensional space that admits only finitely many singularities that are all transverse double points.

In this talk, we consider known (quantum) polynomial invariants for classical knots/links and extend them to singular links. In doing so, an interesting relationship between two distinct state models for the $sl(n)$ -link invariant is revealed. If time permitting, we will also discuss some efforts made in extending these state models to invariants of 4-valent knotted graphs and virtual singular links.

May 2, 2014. 10:00am: Lance Burger (CSUF)

Title: *Exploring the Delta Food Web: A Dominant Eigenvalue Approach*

Abstract: The vast majority of quantitative models representing ecological systems are of a “local” nature, showing the dynamics of competing species, host-parasite, or some combination of the two. These are dynamic because they show how the population sizes change over time and whether the species under consideration persist in the long run. For the most part, only a few species are modeled this way since the data needed for parameters is difficult to obtain. As an alternative, ecosystems can be represented by graphs which are:

- straightforward to generate
- easy to discuss as well as modify, and
- can lead to valuable results concerning the relative importance of each specie in the community to the overall structural stability of the community.

Using a ‘dominant eigenvector’ matrix approach, the overall qualitative structure of ecosystem graphs can be analyzed to qualitatively assess the relative importance of each member of entity in the food-web. This talk will discuss several examples, as well as current research questions in studying the Sacramento-San Joaquin River Delta ecosystem.