Thursday, November 21, 2013
Chapman University

In Von Neuman Hall

The Fifth Joint Mathematics Colloquium
Chapman University - Cal State Fullerton

Organizers: Bogdan Suceavă (CSUF)
Peter Jipsen (Chapman University)

2:00 - 2:20 Fernando Quintino (Cal State Fullerton) – **Interpolating Legendre Multiplier Sequences (**Research Advisor: Tamas Forgacs, Fresno State University)

Abstract: In an attempt to find a class of functions interpolating Legendre multiplier sequences (LMS) we examine the order of an entire function whose zeros belong to a sector which contains the zero loci of quadratic polynomials interpolating LMS. The talk describes our methods, some results, and concludes with open questions.

2:20 - 2:40 Allie Smith and Louis Ehwerhemuepha (Chapman University) **A Novel Exact Test for Association for Small Sample Case-Control Studies** (Research Advisor: Cyril Rakovski)

Abstract: We propose a novel exact test for association between a multiallelic marker and a phenotype with small sample case-control data. In these settings, the case-control genotype data follow multinomial distributions but classical large-sample chi-square contingency table methods are not applicable. The approach enumerates all samples under the non-completely specified null hypothesis of equality of the underlying multinomial distributions and calculates p-values as the sum of the probabilities of the samples as likely or less likely to occur than the observed data. We performed an extensive simulation study to assess the type I error rates under various null hypothesis and at several alpha levels. The number of all possible samples is a product of large binomial coefficients that make the full calculation computationally intensive. Thus, we developed a fast version of the algorithm that reduces the computational time by a factor of 1000 based on the idea of a selective removal of samples with very low probabilities while controlling the precision of the estimated exact p-values. Our results show that the new method possesses a conservative type I error in all scenarios due to the absence of adjustment in this nonparametric technique for the estimation of common multinomial probabilities under the null. It is a viable association approach that attains moderate power to detect deleterious mutations with very large effect sizes even with small sample data. The proposed method is readily extendable to haplotype data and even multimarker genotype data with haplotypes phase uncertainty. In the latter case, the EM algorithm can be implemented to determine weighted haplotype assignments of all subjects based on the

haplotype pairs compatible with the unphased genotypes. We provide estimation for the loss of power due to phase uncertainty in computationally tractable scenarios.

2:40 - 3:00 Nathan Robertson, Susan Deeb, Soeun Park, and Reina Galvez (Cal State Fullerton) **A Comparative Analysis of Three Clustering Techniques with an Application to K6-11 Mathematics Achievement Data** (Research adviser: Sam Behseta)

Abstract: In this research project, we consider three clustering techniques namely, hierarchical distance based clustering, model based clustering, and k-means in order to classify K6-11 students in Orange County, California based on their performances in California Exit Exam, GPA, California Standardized Tests, as well as, demographic parameters such as ethnicity and gender. Through an extensive simulation study we select a clustering method whose misspecification rate is lowest.

3:00 - 3:20 Kevin Gomez (Cal State Fullerton) - **A Ladder of Curvatures for Hypersurfaces in the Euclidean Ambient Space** (Research Adviser: B. Suceava)

Abstract: We introduce a string of new curvature invariants of a hypersurface in the real *(n+1)*-dimensional space and we establish a ladder of inequalities involving these curvature invariants. There is an analogy between this series of inequalities and the classical ladder of power means for positive real numbers. To describe the natural geometric interpretation of our proposed construction, we refer to B. Riemann's original idea of sectional curvature. This presentation is part of a joint work with B. Brzycki, M. Giesler, L.H. Odom, and B. D. Suceava.

3:20 - 3:40 Melissa Riddle (Cal State Fullerton) - **A Pinching Theorem for Three-Dimensional Hypersurfaces in Euclidean Ambient Space** (Research Adviser: B. Suceava)

Abstract: The amalgamatic curvature is a natural geometric quantity whose construction parallels the construction of classical scalar curvature. Its role in a ladder of curvatures corresponds to the role of harmonic mean in the classical ladder of power means, i.e. the mean of power -1. In the present work we prove that if a three-dimensional hypersurface behaves near an arbitrary point almost "like a sphere", the weaker curvature invariant given by the amalgamatic curvature bounds the range of the more rigid curvature invariant, the absolute mean curvature, which is defined as the sum of absolute values of principal curvatures.

3:40 - 4:00 Kyle Lee (Chapman University) - **Investigating Quantum Gravity through Causal Dynamical Triangulations** (Research Adviser: Steve Carlip, UC Davis)

Abstract: Causal Dynamical Triangulation is a numerical approach that provides a non-perturbative formulation of quantum gravity. CDT has successfully produced both classical solutions in the limit and novel quantum prediction that is unseen in General Relativity. This talk will explain general features of CDT and some of the current works being explored.