

ILM0-Schedule-Nov 9, 2019

9:00-9:50: Registration and Breakfast in Math Library, 3rd floor, Neckers.

9:50-10:00: Welcome and Introduction of Dr. Philip Feinsilver

10:00-10:50: **Dr. Feinsilver's Address:**

What are Krawtchouk polynomials?

Short talks are in slots of 30 minutes each: 25 mins + 5 mins for questions.

Don't worry if you go over your time by a few minutes.

11:00-11.30 William Holt (SIUC)

Equilateral triangles from cubes: A geometric/artistic journey through the game of Minecraft

The global phenomenon Minecraft is a game about mining, crafting, punching trees for wood, defending your homestead from the undead, and a very strict adherence to the rule that every built object in the world must be constructed out of cubes. Given these constraints, it is still possible to construct numerous regular and semi-regular polyhedra with perfect or near perfect precision. This presentation will quickly introduce methods of constructing such polyhedra, as well as exhibit various complicated geometric objects that have been constructed using these methods.

11:30-11.45 Break

11.45-12.15 Gihanee Senadheera (SIUC)

Existence of PAC concept classes of incomparable degrees

Probably Approximately Correct (PAC) Learning is one of the models used in machine learning. This model was proposed by L. Valiant in 1984. The work related to this abstract was inspired by the Post's problem. Post classified computably enumerable (c.e.) sets and their degrees and was interested in finding more than two c.e. degrees. This was known as the Post's problem. In 1957 Friedberg and Muchnik independently showed this is possible. In the PAC learning model, there are concept classes which are learnable; and also there are concept classes which are hard to learn. Later mathematicians were able to postulate the notion of PAC reducibility. That is, if a concept class C_0 is PAC learnable through an algorithm, then the

concept class C_1 reducing to the concept class C_0 means C_1 can be learned through the existing algorithm for C_0 . The term PAC degree means degree of unsolvability of a PAC concept class. It is natural to ask the question whether there are incomparable PAC degrees. In order to prove that there are incomparable PAC degrees we use the method known as priority construction, which is used by the two mathematicians Friedberg and Muchnik in their work. We construct two concept classes C_0 and C_1 such that C_0 is not reducible to C_1 and C_1 is not reducible to C_0 .

12.15-12.45 Roshini Gallage (SIUC)

Approximation of continuously distributed delay equations

We present a theorem on the approximation of the solutions of delay differential equations with continuously distributed delay with solutions of delay differential equations with discrete delays. We present numerical simulations of the trajectories of discrete delay differential equations and the dependence of their behavior for various delay amounts. We further simulate continuously distributed delays by considering discrete approximation of the continuous distribution.

12.45-1.45 Lunch in Math Library

1.45-2.15 Eric Odoom (SEMO)

Predicting Healthcare Expenditure: A Combination of Machine and Statistical Learning Methods

This study examines various predictive machine and statistical learning models for healthcare expenditure. In the literature on healthcare spending, a wide number of statistical models have been proposed. Very recently, machine and statistical learning methods have taken the center stage in many areas of research, from computer science to finance. While machine learning is an application of artificial intelligence through a series of algorithms that are optimized on data samples, statistical learning is a framework for understanding data based on statistics. Despite the increasing usage in different fields of research, applications of particularly machine learning in healthcare expenditure are relatively scarce. The evolution statistical learning methods and revolution of old methods in recent years has proven to increase accuracy when considered for application. We conducted a systematic literature review and identified some machine learning methods (Classification

and Regression Trees (CART), Bootstrap Aggregation (Bagging), Random Forest and Boosting) and statistical learning (Regularized Regression: Least Absolute Shrinkage and Selection Operator (LASSO) and Elastic Net) methods used for predicting healthcare expenditure. To improve the predictive performance, we propose a new methodology using Artificial Neural Network (ANN) with one hidden layer and the rectified linear unit (ReLU) activation to combine the Decision Tree, Bagging, Boosting, LASSO and the ENET models into a single model. We compared the performance of the individual models as well as the combined model via a simulated data. The Mean Square Error (MSE) was used as the metric to measure the predictive accuracies of the fitted models. The metric reveals that the combined model using the ANN achieved the least MSE which shows the superiority of the proposed method.

2:15-2:45 Daniel Davidson (SIUC)

Generalization of Transitivity to the Integers

Introduction of a notion of transitivity which extends to the integers, i.e. a notion of z -transitivity. Two theorems are proven involving dependencies between different forms of transitivity.

2:45-3:15 Guy Brawley, Mason Doyle (UTM)

Wasserstein distance between certain approximations of self-similar measures

We study the 2-Wasserstein distance between certain discrete approximations of self-similar measures. We find upper and lower bounds for the distance between these approximating measures. As a consequence, we improve the lower bounds previously obtained and match the best known upper bounds for the 2-Wasserstein distance between self-similar measures.

3:15-3:30 Break

3:30-4:00 Ryan Steele (SIUC)

Combinatorial Game Theory

A introductory discussion on the field of combinatorial games. Topics include different categories of combinatorial games and their solved status, as well as some of the methods used in solving a game.

4.00-4.30 Priyan De Alwis (SIUC)

Fourier Methods for Estimating the Central Subspaces in Time Series

The main objective of time series analysis is to make inference about the conditional mean and the conditional variance functions. Using the Fourier transformation, we have developed a new statistical method to estimate the conditional mean and variance functions of a nonlinear time series. To this end, we have derived the candidate matrices that their column spaces span the central subspaces efficiently. The estimated subspaces are used to estimate the conditional mean and variance functions of the given model. Simulation results for different types of time series models are presented to evaluate the performance of the proposed method and compare it with other existing methods.

4.30-5.00 Wiranthe Herath (SIUC)

Tensor regression analysis for high dimensional data

Many real data are naturally represented as a multidimensional array called a tensor. In classical regression models, the predictors and covariate variables are considered as a vector. However, due to high dimensionality of predictor variables, these types of models are inefficient for analyzing multi-dimensional data. In contrast, tensor structured models use predictors and covariate variables in a tensor format. Tensor regression models can reduce high dimensional data to a low dimensional framework and lead to efficient estimation and prediction. The results of simulation study and numerical analysis will be presented.

POSTER

Bohdan Paikoush (SIUC)

Socio-economic data analysis of Jackson and Williamson county

As per the data released by the U.S. Census Bureau, more than 80% of the Illinois Counties saw a population decline in 2017. In this study, we focused on Jackson and Williamson County of Southern Illinois and analyzed the socio-economic factors directly impacting the resident population of these two counties for the period 2010-17. The population, educational attainment,

household income, unemployment rate, and poverty data were obtained and compared with the state average.

5.00 Closing remarks, end of conference.

Thanks for coming, safe journey home, and perhaps see you in two years time.