AARMS-CMS Student Poster Session
Présentations par affiches des étudiants - AARMS-SMC
(Org: **William Verreault** (Laval))

ELSAYED GHANEM, Memorial University
Shrinkage Estimators for Mixture of Logistic Regression Models

The logistic regression model is one of the most powerful statistical methods, widely used in many fields to analyze binary data. The logistic regression enables researchers to use a set of covariates to explain the classification of binary responses. The collinearity problem is one of the most common problems in logistic and mixture of logistic regressions where the covariates are highly correlated. This research developed ridge and Liu-type estimators to deal with the collinearity problem in a mixture of logistic regression models. Through various numerical studies, we show that the developed Liu-type method provides more reliable results in estimating the coefficients of the logistic regressions.

STEVEN KENDELL, Memorial University of Newfoundland-Grenfell Campus
(α) and (r,s)-Power Divergences

We define the (α) and (r,s)-power divergences that can be regarded as the generalized Kullback-Leibler divergence.

$$D_{KL}(x, y) = \sum_{i=1}^{n} x_i \ln \frac{x_i}{y_i}$$

We explore their relationship with various other entropy's and divergences using limits. We also study and determine their geometric properties such as continuity and convexity. Finally, using the positive and negative definite kernels, we investigate the metric property of our (r,s)-power divergences.

ALEXANDRA KIRILLOVA, Waterloo University

MOKHWA LEE, Stony Brook University
Multi-secant extensions of BFGS

When dealing with a large-scale optimization problem, classical second-order methods, such as Newton's method, are no longer practical because it requires iteratively solving a large-scale linear system of order n. For this reason, Quasi-Newton(QN) methods, like BFGS or Broyden's method, are introduced because they are more efficient than Newton's method. This project focuses on multi-secant extensions of the BFGS method, to improve its Hessian approximation properties. Unfortunately, doing so sacrifices the matrix estimate's positive semi-definiteness, and steps are no longer assured to be descent directions. Therefore, we apply a perturbation strategy, inspired by the 'Haynsworth inertia additivity formula', to construct an almost-secant positive-definite Hessian estimate matrix. This strategy has a low computational cost, involving only rank-2 updates with variable and gradient successive differences. We also explore several ways of improving this method, accepting and rejecting older updates according to several nondegeneracy metrics. Future goals include extending these techniques to limited memory versions.

LEXI NASH, Concordia University of Edmonton
Enumerating Positions of Distance Games

Combinatorial games are two player games with no chance elements and no hidden aspects. Distance Games are a class of combinatorial games in which pieces are placed on a board such that they are the proper distances from previously placed pieces. The polynomial profile of a game on a graph encodes the number of positions with a fixed number of vertices from each player. We extend previous work on finding the polynomial profile of the games COL, SNORT, and CIS played on paths to other types of graphs. We also give recursions and generating functions for the polynomial profiles of generalizations of these three games when played on paths.

GAVIN OROK, University of Waterloo
MathSoc Cartoons and Edu-Action!: Engaging Math Education with Artistic Resources

Math is notorious for being a problem concept in school because many students see it as confusing, highly abstract, and boring. Some causes of this are the highly technical nature of the subject and, with pure mathematics, the lack of immediate real-world connections. As a consequence of this perception of the subject, students often develop a debilitating emotional reaction to math called math anxiety and achieve lower academic performance in math.

To try to combat this perception of the subject, I experimented with two artistic projects during my undergraduate degree: MathSoc Cartoons and Edu-Action!. In these projects, students produce artistic educational resources for their peers that give high-level overviews of complex math topics as supplements to traditional course materials. These resources include cartoons, posters and videos that explain ideas simply, demystify the theory with relevant applications and analogies, and incorporate colourful artwork and fun characters to make the material engaging.

In this poster we will explain design techniques in these resources that attempt to make the material fun and easy to understand, the merits of different styles of resources, student feedback on our work, and challenges we encountered along the way. In addition, we will offer suggestions for how instructors can implement similar resources into their classes and possible uses for these types of resources outside of math.

ALAINA PARDY AND ABIGAIL ROWSELL, Memorial University of Newfoundland Grenfell Campus
Analyzing Distance-Regular Graphs Arising From Primitive Groups

Using the GAP software system, we investigated distance-regular graphs on up to 4095 vertices that arise from primitive permutation groups. The graphs obtained were categorized based on the number of vertices they had; those that were a prime or prime power and those that were not. The various built-in commands in the GAP software allowed us to determine multiple properties of each graph. This included the group, rank, orbitals, and intersection array. This information helped identify graphs included in common families such as the Paley, Peisert, Hamming, Johnson, Kneser, and Grassmann graphs. During our research, we came across a graph that we concluded was unknown. This graph has 136 vertices, arises from the group $PSL(2,17)$ with rank 12, and has intersection array $\{63, 32; 1, 28\}$, so is strongly regular with parameters $(136, 63, 30, 28)$. The graph $NO_8^-(2)$ also has these parameters. We further investigated both the unknown graph and the graph $NO_8^-(2)$ (and their complements) to determine how similar they were in terms of the clique number, chromatic number, and independence number. We concluded that the unknown graph and $NO_8^-(2)$ have many different properties.

XIAO YANG, Carleton University
A model for 2D art generation

Generative adversarial network architecture has been very successful in image generation, such as creating non-existent images of buildings and pets. However, most of images created are related to real-world objects, there are very few sophisticated networks for creating 2D art images, such as painting and virtual character designs. Because the vanilla GANs or its variants are notoriously hard to train, it's difficult to obtain satisfactory result with traditional structures, hence, we propose a modified generative adversarial network based on progressive training technique, which is well known for generating high quality human facial images, to automatically generate 2D art design using both originally collected and existing 2D art designs.

YIHAN ZHU, University of Windsor
Almost periodic equidistributed functions

There are plenty of periodic motions in our life. However, a linear combination of two or more periodic motions need not be periodic any longer. Almost periodic functions are more general than periodic functions. Therefore, the class of almost periodic functions forms a more suitable object of the study from a structural point of view. Equidistribution, which is also known as uniform distribution, is an important concept in many areas including number theory, ergodic theory, probability, and theoretical computer science. As we know sequence is a special case of function. With this knowledge, the main idea of the research was to generalize the existing concept of equidistributed sequences to equidistributed functions by using the property of the invariant mean on almost periodic functions. In the research, we first define 'equidistributed functions' with values in topological spaces, then give a necessary and sufficient condition for this kind of equidistribution. Following this, due to interest in almost periodicity, we define the notion of 'almost periodic equidistribution' and prove an analog of the Weyl criterion for such equidistributed functions. Finally, as an application, a generalization of Van der Corput's difference theorem is proved. This presentation is based on part of the results of my thesis, which supervised by Dr. Mehdi S. Monfared.