Machine learning in finance
L'apprentissage automatique en finance
(Org: **Michael Chen** (York), **Hyejin Ku** (York), **George Lai** (WLU) and/et **Hongmei Zhu** (York))

MICHAEL CHEN, York University

VICTOR HUANG, York University

YINGYAN JIA, Wilfrid Laurier University

ROY KWON, University of Toronto
Data-driven Integration of Norm Penalized Mean-variance Optimization

Mean-variance optimization (MVO) is known to be sensitive to estimation error in its inputs. Norm penalization of MVO programs is a regularization technique that can mitigate the adverse effects of estimation error. We augment the standard MVO program with a convex combination of parameterized L1 and L2 norm penalty functions. The resulting program is a parameterized quadratic program (QP) whose dual is a box-constrained QP. We make use of recent advances in neural network architecture for differentiable QPs and present a data-driven framework for optimizing parameterized norm-penalties to minimize the downstream MVO objective. Historical simulations using US stocks and global futures data demonstrate the benefit of the integrated data-driven approach.

YONGZENG LAI, Wilfrid Laurier University
Stock indices and prices prediction using CNN-BiLSTM-Attention model

Stock price prediction is important and challenging. Accurate prediction of stock price helps investors to make investment strategies. Based on characteristics of stock data such as nonlinearity and time series, a stock price prediction method based on CNN-BiLSTM-Attention model is presented. In our study, first, the convolutional neural networks (CNN) and Bi-directional long short-term memory (BiLSTM) networks are used to extract time-series features of serial data. Then, the attention mechanism is introduced to fit weight assignments to information features, and last, the prediction results are output through the dense layer. Empirical studies using historical data from China and North American markets will be presented. This is joint work with L. Ye, J. Zhang, and Y. Lai

CHIFENG SHEN, York Univeristy
Bayesian Online Changepoint Detection in Finance

Changepoints are utilized to split a data sequence into non-overlapping segments. The Online detection of changepoints method can be applied in many fields, especially in finance. In this talk, the case where the parameters between the segments are independent is examined, and an online algorithm for computing the probability of the most recent changepoint is derived.

YAODE SUI, Wilfrid Laurier University

WEI XU, Toronto Metropolitan University
Random Willow Tree with Application in Risk Management

Derivatives underlying a portfolio is popular on the market to diversify the market risk. However, existing method, the nested simulation, is quite time-consuming for pricing and managing the risk. In this article, we propose an efficient approach, randomized willow tree method. There are three main stages for our approach, portfolio distribution approximation, randomized willow tree construction and managing the risk of derivatives. We first generate some simulated paths to describe the evolution of dynamic portfolio values. Then, the minimal relative entropy (MRE) method is applied to approximate the distribution of portfolio values at each time based on the simulated data. After the approximated distributions are determined, a randomized willow tree can be constructed for pricing and managing the risk of derivatives underlying the portfolio. Finally, we apply the proposed approach to calculate annual dollar delta, 99% VaR and CVaR of a particular derivative, i.e., a 19-year variable annuity with guarantee riders. This application demonstrates the efficiency and accuracy of the proposed approach compared with the common nested simulation technique, especially for a large pool of derivatives underlying the same portfolio.