AI/Optimization/Finance
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MICHAEL CHEN,

ROY KWON, University of Toronto
Generalized risk parity portfolio optimization: An ADMM approach

The risk parity solution to the asset allocation problem yields portfolios where the risk contribution from each asset is made equal. We consider a generalized approach to this problem. First, we set an objective that seeks to maximize the portfolio expected return while minimizing portfolio risk. Second, we relax the risk parity condition and instead bound the risk dispersion of the constituents within a predefined limit. This allows an investor to prescribe a desired risk dispersion range, yielding a portfolio with an optimal risk–return profile that is still well-diversified from a risk-based standpoint. We add robustness to our framework by introducing an ellipsoidal uncertainty structure around our estimated asset expected returns to mitigate estimation error. Our proposed framework does not impose any restrictions on short selling. A limitation of risk parity is that allowing of short sales leads to a non-convex problem. However, we propose an approach that relaxes our generalized risk parity model into a convex semidefinite program. We proceed to tighten this relaxation sequentially through the alternating direction method of multipliers. This procedure iterates between the convex optimization problem and the non-convex problem with a rank constraint. In addition, we can exploit this structure to solve the non-convex problem analytically and efficiently during every iteration. Numerical results show that this algorithm converges to a higher quality optimal solution when compared to the competing non-convex problem.

GEORGE LAI, Wilfrid Laurier University
Asset price prediction by CNN+LSTM

Prediction of asset prices is difficult due to the nature of asset prices. Traditional statistical models and some basic machine learning, as well as deep learning techniques, were used in forecasting stock prices in the literature. In this talk, we will introduce our recent work on asset price prediction using some deep learning-based techniques. Various asset prices from different industries in both developed and emerging markets are selected to test the algorithms. Our test results show that the convolutional neural network (CNN) and the long short-term memory (LSTM) based algorithm outperforms other selected neural network-based algorithms and some traditional time series models (e.g., ARIMA and GARCH).

ADAM METZLER, Wilfrid Laurier University
A General Framework for Modelling PD-LGD Correlation in Loan Portfolios (Some Interesting Observations)

Economic capital is defined as capital that banks are legally mandated to hold as a cushion against severe losses. The Basel Committee on Banking Supervision (BCBS) imposes strict guidelines on how economic capital is to be calculated, and those guidelines require a detailed understanding of so-called PD-LGD correlation. We show that a number of PD-LGD correlation models that have been proposed in the literature are special cases of a more general framework, and analyze this framework in detail. We highlight several (potentially dangerous) features of the framework that have not been addressed in the literature, and of which we believe most end users are unaware. For instance the model parameters are overidentified, and the link between model inputs and outputs can be surprisingly counter-intuitive. This is joint work with R. Mark Reesor and Wisdom S. Avusuglo.

DAVID SAUNDERS, University of Waterloo
Bounds on CVaR with given Marginals and Counterparty Credit Risk

We consider the problem of bounding conditional value-at-risk of a random variable that is a nonlinear function of two sets of risk factors whose marginal distributions are known, but whose joint distribution is unknown. We will discuss theoretical results including an analogue of the Kantorovich duality from optimal transport, and convergence and error distributions for problems with simulated data. Applications to counterparty credit risk will also be discussed.

LUIS SECO, Toronto

CHENGGUO WENG, University of Waterloo
When Does The $1/N$ Rule Work?

The 1/N rule provides a simple way to obtain a diversified portfolio. Studies have shown it often outperforms more sophisticated approaches. We show that the 1/N rule only outperforms an optimal portfolio in two out of seven major equity markets: the USA and Japan. We develop a market-specific measure that indicates when the 1/N rule will dominate. Our measure is based on the distance between the 1/N portfolio and the maximum Sharpe ratio portfolio. We label it the 1/N favorability index. The 1/N rule also does well when the market as a whole performs well and we analyze the joint contribution of this factor and the favorability index. This is a joint work with Danqiao Guo, Phelim Boyle, and Tony Wirjanto.

JIE XU, George Mason University
Monte Carlo tree search with optimal computing budget allocation

We analyze the tree policy in Monte Carlo tree search problem with the objective to select the best action at the root that achieves the highest cumulative reward. We propose a new tree policy that optimally allocates a limited computing budget to maximize a lower bound on the probability of correctly selecting the best action. The new tree policy takes a more balanced approach to manage the exploration and exploitation trade-of compared to the widely used Upper Confidence Bound (UCB) type of tree policies when the sampling budget is limited. In addition, the new policy does not need to know the support of reward distribution, which UCB requires in order to function. Another advantage of the new tree policy is it can be applied to game trees with mild modifications. We illustrate the efficiency of our algorithm using a widely used benchmark problem.

YONGGAN ZHAO, Dalhousie University
Option Pricing with Economic Regime Shifts

Assuming that one-period logarithmic returns of the underlying asset follow a hidden Markov process, we develop a valuation model for European call options. Unlike existing option pricing models, our pricing mechanism relies on the optimal non exponential-affine stochastic discount factor characterized with economic strength. Monthly S&P 500 index options for the period from January 2014 to October 2018 are used for model validation. It is found that risk/return profiles under the optimal risk neutral probability measure associated with a non exponential-affine stochastic discount factor are drastically different across the regimes of economic strength. We use both the absolute pricing error and the model implied volatility criteria to examine the model performance. In comparison with alternative models, empirically-evidenced unbalance pricing errors for deeply in-the-money and deeply out-of-the-money options are substantially reduced.