

## A Short Course on Financial Data Science and Optimization

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Data science is emerging as an important new solution for financial problems and computational optimization plays critical roles in machine learning and making optimal financial decisions. In these lectures, we will review optimization fundamentals relevant to machine learning and financial optimization. In addition, we will discuss optimization methods for CVaR risk minimization, kernel methods for rare class (anomaly) detection, data driven learning for option hedging, and computing neural networks (NN) for optimal stochastic dynamic asset allocations.

### Outline:

Lecture 1-2, Day 1: Convexity, optimality, and optimization algorithms

Lecture 3-4, Day 2: Efficient portfolio CVaR risk minimization

Lecture 5-6, Day 3: Effective rare class (anomaly) detection

Lecture 7-8, Day 4: Data-driven neural network approach to asset allocation

Lecture 9-10, Day 5: Learning minimum variance discrete hedging from market

## References:

- [1] Minimizing CVaR and VaR for portfolio of derivatives, S. Alexander, T. F. Coleman, and Y. Li, *Journal of Banking & Finance* 30 (2), 583-605, 2006.
- [2] RankRC: Large-scale nonlinear rare class ranking, A Tayal, TF Coleman, Y. Li, *IEEE Transactions on Knowledge and Data Engineering* 27 (12), 3347-3359, 2016
- [3] Learning minimum variance discrete hedging directly from the market, K. Nian, T.F. Coleman and Y. Li, *Quantitative Finance* 18 (7), 1115-1128, 2018
- [4] A data-driven neural network approach to optimal asset allocation for target based defined contribution pension plans, Y. Li and P.A. Forsyth, *Insurance: Mathematics and Economics* 86, 189-204, 2019
- [5] *Convex Optimization*, L. Vandenberghe and S. Boyd, Cambridge University Press

## Short Bio

**Yuying Li** is a professor at Cheriton School of Computer Science, University of Waterloo in Canada. Prior to joining Waterloo, she was a senior research associate in Computer Science Department at Cornell University 1988-2005. She is the recipient of the 1993 Leslie Fox first Prize in numerical analysis at Oxford England. Her main research interest includes financial data science (including supervised and unsupervised learning, clustering, anomaly detection, fraud detection, and data driven optimal decision), computational finance, and computational optimization.

Li has been an associate editor of the *Journal of Computational Finance* (since 2008), the *Journal of Finance and Data Science* (since 2015). Li has been on the Advisory Board of the *Journal of Financial Innovation* since 2017. Presently, Li is the (graduate program) Director of Data Science at University of Waterloo.