Syllabus: Risk and Portfolio Management with Econometrics (Spring 2018)

We will cover *data-driven investment management techniques and tools*. We shall be concerned mostly with the universe of stocks (equities) and ETFs. (If time permits, we will discuss cryptocurrencies). The class will cover (i) data collection and preparation, (ii) basic modeling of stock returns, (iii) risk measures (iv) portfolio construction, (v) risk management (vi) quantitative strategy design, including various examples and exercises.

The class will involve approximately 6 assignments involving market data (e.g. model the correlation matrix of the stocks in the Russell 2K index, or create and test a strategy for trading a portfolio of technology stocks).

Pre-requisites: linear algebra, probability, statistics, optimization. Knowledge of *at least one* of the following programming languages: VBA, Python, Matlab. Some exposure, or at least interest, in stock markets.

1. Introduction to data collection in finance (equities)
   - 1.1 Where to get stock return data?
   - 1.2 What software to use?
   - 1.3 Dividends, splits, corporate events
   - 1.4 Where to get interest rates & dividends?
   - 1.5 High frequency data/ EOD data

2. Basic operations with stock data
   - 2.1 Computing returns, expected returns & volatility
   - 2.2 Adjusted prices (dividends, splits, corporate events)
   - 2.3 Fitting the returns statistics to probability distributions
   - 2.4 Covariance, correlation matrices
   - 2.5 Spectral theory for random covariance matrices: Marcenko-Pastur
   - 2.6 Regressions

3. Factor models
   - 3.1 Mean-variance optimization
   - 3.2 CAPM
   - 3.3 Fama-French factors
   - 3.4 ETFs and industry sectors/factors
   - 3.5 Multi-factor models APT
   - 3.6 Correlations of fundamental factors
   - 3.7 Orthogonal factors, eigenportfolios

4. Risks associated with equities
   - 4.1 Fat tails
   - 4.2 Macro risk
   - 4.3 Sector risk
   - 4.4 Idiosyncratic risk

- 4.5 Headline risk
- 4.6 Earnings
- 4.7 Takeovers and corporate events

5. Quantification of risk-reward
   - 5.1 Value-at-Risk
   - 5.2 Expected Shortfall
   - 5.3 Worst drawdown
   - 5.4 Time in drawdown
   - 5.5 Sharpe Ratio
   - 5.6 Opportunity cost

6. Trading Styles
   - 6.1 Passive investing or indexing
   - 6.2 Active investing
   - 6.3 Market timing
   - 6.4 Holding periods
   - 6.5 Quantitative Investing

7. Exchange-traded funds
   - 7.1 Stock index trackers
   - 7.2 Leveraged and inverse
   - 7.3 Futures-based
   - 7.4 Exchange-traded notes
   - 7.5 Fees and borrow
   - 7.6 Complex ETFs

8. Cryptocurrencies
   - 8.1 Market structure
   - 8.2 Bitcoin futures
   - 8.3 Bitcoin funds
   - 8.4 Bitcoin ETFs
   - 8.5 Metcalfe's pricing model

9. Quantitative and semi-quantitative strategies
   - 9.1 Mean-reversion
   - 9.2 Momentum
   - 9.3 Financial statements
   - 9.4 Complex ETF arbitrage
   - 9.5 Volatility futures and ETFs
   - 9.6 Statistical Arbitrage