Project Proposals for MS&E 448

Spring Quarter 2016

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1 Build a High Frequency Price Movement Strategy

Students will have access to Tradeworx and Thesys data and simulator. Access order book data. Use this data to predict short term price movements:

- Can information in the order book be used to predict price movements?
- On a tick-by-tick time scale?
- On a larger time-scale (for example, can an integrated order book profile predict anything over longer horizons?)

Discuss and analyze execution tactics (eg if you are aggressing, can you really get that price? How much slippage do you expect? Adverse selection?) Hands-on experience with what cutting-edge traders face in real life. Unique opportunity that this API is offered to students.
2 **Build a classical statistical arbitrage strategy**

- Data: Clean it, make sure adjusted for corporate actions etc.
- Build groups: sectors, clusters.
- Define residual returns.
- Predict residuals: O-U process or other statistical techniques, etc.
- Create a portfolio: Optimize for risk, transaction costs, liquidity etc. Convex linear optimization techniques. Can be intra day or daily.
- Simulate! Quantopian
- Data: Bloomberg, Quantopian, Thesys.
- Language: Python
3 Fundamental signals (value, growth, earnings forecast) for stock price prediction

- Data: Quantopian, Estimize, Quandl
- Create a set of signals for stock price prediction based on fundamental data
- Put together a portfolio combining those signals
- Simulate
- Language: Python
- Literature: Quantopian blog posts, Ernie Chan’s blog post
4 Build a stochastic model for order book dynamics and execution

- Data: Tradeworx and Thesys Data
- Represent the statistics of the order book.
- Or model for example as Hawkes process
- Follow papers in the literature, and calibrate or verify those models based on the data or come up with your own model!
- Can you use this to design a short term price forecasting or market making model?
5 Trading over multiple horizons

- Data Quantopian (stocks) or Bloomberg (Futures)
- Build a suite of predictors. You may use technical analysis-type signals
- Create forecasts over multiple horizons
- Build a portfolio that utilizes multi period optimization
- Take into account risk (correlations), transaction costs when doing portfolio optimization
- Convex optimization techniques
- Language: Python
- Simulate: Quantopian?
- Literature: Quantopian blog posts etc.
- Literature: Prof. S Boyd’s website
- Literature: Trend Following with Managed Futures: The Search for Crisis Alpha (Wiley Trading) 1st Edition by Alex Greyserman (Author), Kathryn Kaminski (Author)
6 Design a market making algorithm

- Place an order to sell above the market price
- Place and order to buy below the market price
- Make money on the bid-ask spread
- Problems:
  - You are competing with others.
  - You have to manage your inventory risk
  - Will you lay-off some risk in correlated markets?
- What other problems are there?
- Data: Tradeworx
7 Machine Learning for Quarterly Stock Prediction

- You will be provided unique data sets
- Use Machine Learning techniques
- Featurize and classify the data to find variables that are predictable of 1 month - 3 month returns
- Simulate
- Data: Cerebellum, Quantopian
- Language: Python or Matlab
8 Sharpe ratio, Sortino, what summary statistic to use to best predict out of sample performance

- Data: Cerebellum, Quantopian, Thesys

- Given a strategy, what is the best measure to predict out of sample returns?

- How to avoid overfitting? How much Data do you need?

- Can adding noise help?

- Explore these measures while designing your own optimal strategy

- Or develop measures or machine learning techniques to optimally select which strategies will perform (given a set of strategy returns)

- Literature: Differential Privacy


9 A predator-prey model for stock market behavior

- Negative feedback (range bound market, Lotka-Volterra type dynamics)
- Positive Feedback (a trending market, exponential growth, bubbles).
- Model: Stochastic equation with L-V type model for deterministic part of dynamics.
- See if you can calibrate the toy model to find regimes of positive and negative feedback.
- Can you build a trading strategy based on this.
- Data: Daily or intraday, US stocks.
10 Project X

Students may submit their own proposals!

- Must be well formulated
- You may clone ideas from Quantopian platform but you must reference these
- Your own work has to be substantially different if cloned
11 Reading Materials etc.

- Papers will be posted on the class website
- Links to papers may be supplied
- Papers can be read regardless of your project (cross pollination)
- Main work will be done in the iPython notebook environment