UChicago Trading Competition

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Overview

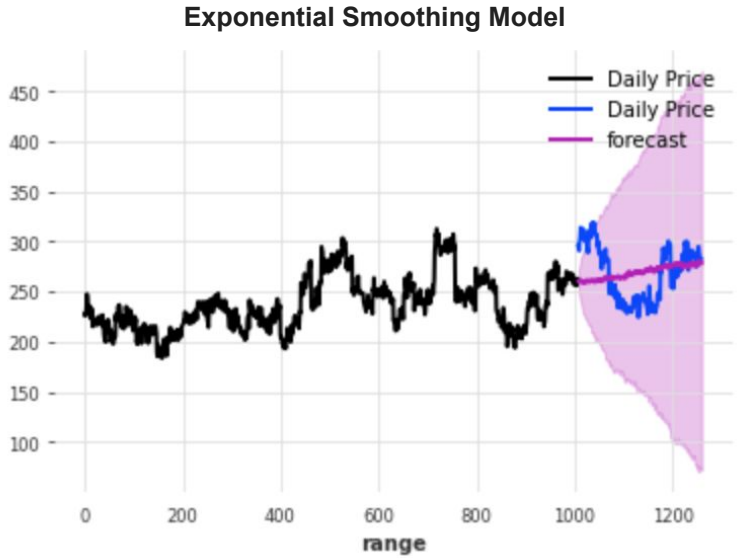
- Team of 4 participants (application needed)
- 3 problem cases with 2-3 weeks to work on
  - Futures market making
  - Trading Options
  - Portfolio Management
- Wrote algorithms / bots in python (with simulated exchange library)

Case 1: Market Making

- Market making lumber futures
- 5 separate futures contracts that expired throughout the year
- Given ~6 years of historical daily price and monthly rain data
- ~4 Trading rounds of 252 tradings days each (1 day = 1 second of trading)
- No access to actual lumber prices when trading (only order book)
- Max hold 100 contracts of each contract at a time (short or long)

Recommended Strategy

- Using Historical data to make model that can predict lumber spot prices given rain data and prior few weeks of data



Recommended Strategy

- With predicted “fair” price we can then device a market making algorithm that maximizes profits while managing risk
- If we knew the market price was above the “fair” price we could take a more short position
- If we knew the market price was below the “fair” price we could take a more long position
- In general try to make as many trades as possible while minimizing the amount of contracts we hold (to limit risk)

Case 1: Our Strategy

- Disregard fair price and make as many trades is possible regardless of risk
- “Penny-in” trade 1-cent in from best bid and ask such that we have the best prices (and will be filled first)
- Set orders outside of the best bid and ask in increments of X (say 20) cents such that if someone aggressive buys/sells we can make a large spread
- By not predicting the fair price we saved time and were able to send orders faster

Case 1: Market Making

Out Strategy:

- “Penny-in”
- “Levels”
- Faster orders

Levels with $2 increments

Case 1: Improvements

- Smarter algorithm that takes into account the fair price such that we can hedge our bets long or short, market taking
- Multi-Threading to have faster trades (winning team strat)
- Risk management and balancing the amount of contracts we are holding
    - Be able to liquidate positions without slippage (using “fade”)
    - Benefit from being able to fulfill more trades rather than hit risk limits and not be able to trade
- Being more creative and using bogus orders to throw off other teams

Case 2: Options Trading

- Trade Put and Call options contracts on a single stock
- 5 separate options contracts (with different strikes)
- Similar to case 1 but given historical options prices with the greeks
- Risk limits based on greeks (if passed account is liquidated)
- Simulated volatility spikes or “triggers” in the market that can cause the price of options to change widely

Case 2: Recommended Strategy

- Create a model to calculate the volatility of the underlying
- Implement Black-Scholes Model that could price options based on the greeks
- Using the pricing model find opportunities to market take and or market make (if we knew the best price how should we put orders around it?)
- Limit risk by accounting for number of contracts held as well as greek limits

Case 2: Our Strategy

- We did create a market pricing model using black-scholes but in the end didn't use it
- Used the same strategy as case 1 to market make
  - "Levels" and "penny-in" but now with options contracts
- Managed risk by hedging our bets
  - If we were long too many contracts we would short more
  - If we were short too many contracts we would go long more
- Managing Risk allowed us to have steady profits and avoid hitting risk limits as often (which ultimately was our best attribute in this case)

Case 2: Improvements

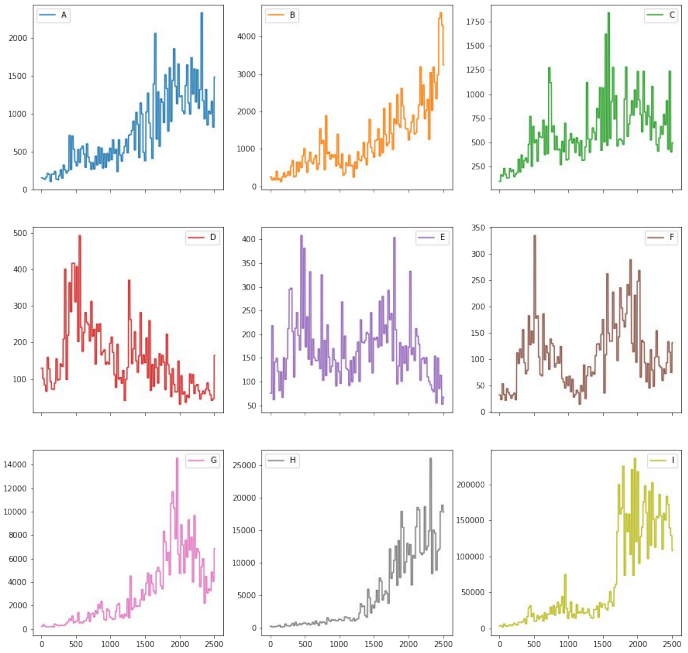
- Model worked super well up until the end of trading where our contracts that we held were cash settled
  - We held many short positions and it just so happened that every trading session the price of the options were inflated relative to the Black-Scholes model price, thus a good size loss was incurred from the contracts
  - Solution: close out of all positions towards the end of the trading cycle
- Use Black-Scholes Model to keep track if we are buying or selling contracts that are unreasonable to hopefully not inflate price
- Do market take on good deals (based on Black-Scholes)
- Handle Risk better (for the most part worked well)

Case 3: Portfolio Management

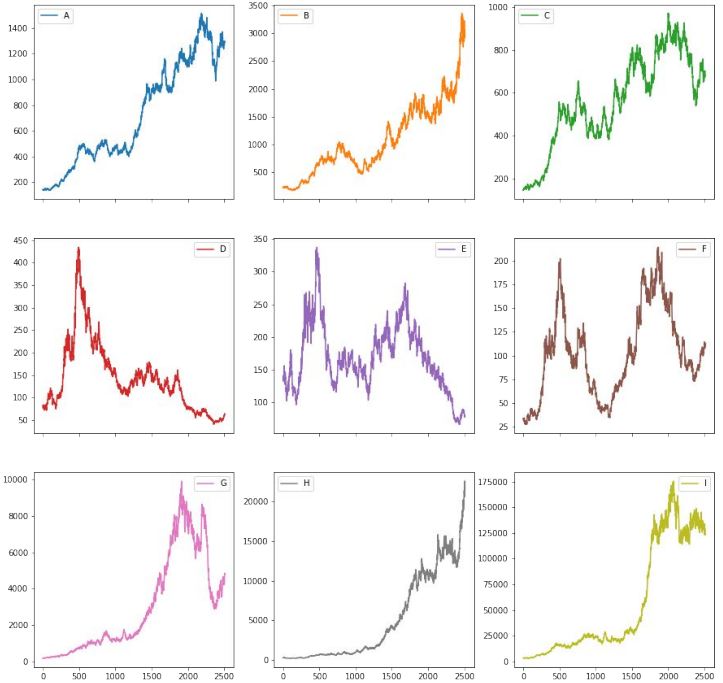
- Given a portfolio of 9 stocks that we can manage what percent we are invested in each, and re-adjust each day
- Goal is to have the best Sharpe ratio (basically: returns / variance)
- Given 10 years of price performance data, and 3 analyst predictions on each stock for the same period of time

Case 3: Portfolio Management

Analyst 1 Predictions

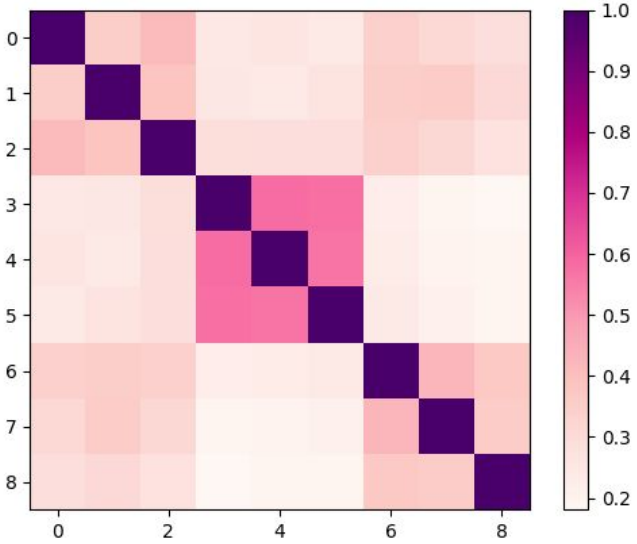


Stock prices

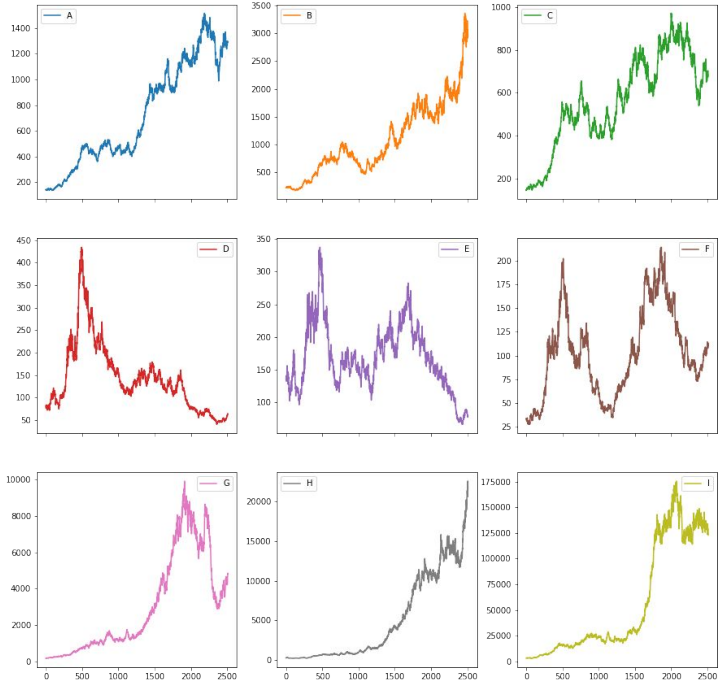


Case 3: Portfolio Management

Correlation



Stock prices



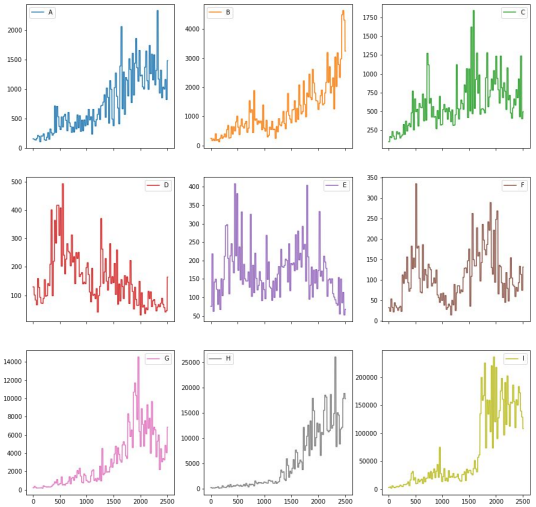
Correlation 1

Correlation 2

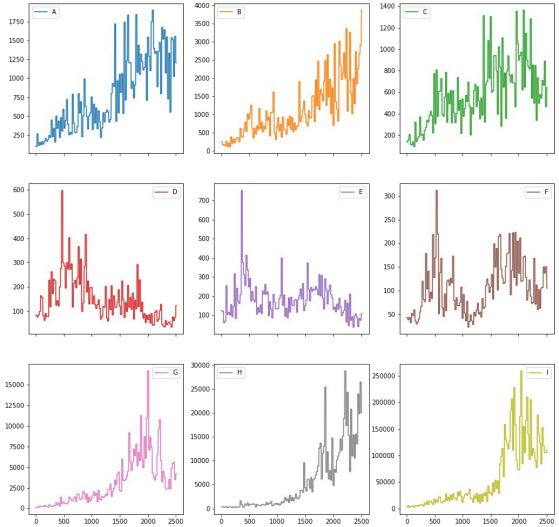
Correlation 3

Case 3: Portfolio Management

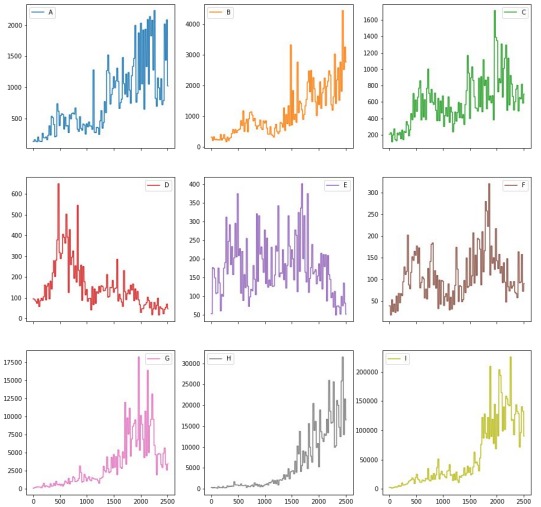
Analyst 1 Predictions



Analyst 2 Predictions



Analyst 3 Predictions



Case 3: Recommended Strategy

- Markowitz portfolio theory
- Risk Parity Allocation
- Black-Litterman (predict expected returns with analysts predictions)
- Strategies somewhat covered MATH 423 (Jaewoo goated)

Case 3: Our Strategy + Takeaways

- Risk Parity Allocation and Black-Litterman (as per the spec recommended)
- Grouped stocks by correlation (less assets to trade lead to lower variance)
- Weighted Average of Analysts predictions (hand dialed hyperparameters)
- Could have been more creative and attempted the use of ML to some degree (we did attempt but ran out of time)

Takeaways

- Be Creative and Experiment!
- Work early and research current techniques
  - Blogs were super useful for the competition + the spec was pretty detailed
- Work with a group of good people
  - A good team goes a long way
- Have Fun!