Quantitative Assessment - Xinlu Tu

1. Process flow chart

Hedge Ratio

NASDQ 100 stock returns

2007.1.1 - 2013.07.21

- Principal component analysis (PCA)
- Correlation matrix

Two methods to find high correlated stocks Details listed in folder 'Collect data and Pick stocks'

Correlation

Cointegration

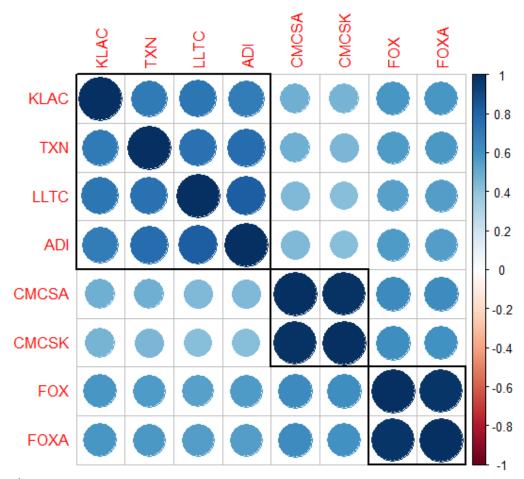
Dynamic Hedge

- Choose three highly correlated stocks : KLAC, LRCX, TXN
- Each optimal hedge ratios among three stocks are determined based on Minimum Variance Portfoilo and Lagrange Multipliers
- The Sharpe Ratio is significantly increased from 0.06 to 0.95
- Details listed in folder 'Dynamic hedge'

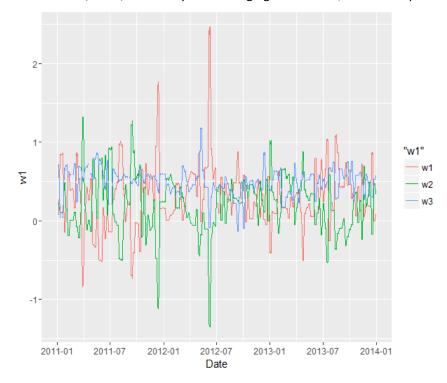
Cointegrated Pair Trading

- Choose a cointegrated pair of stocks: CMCSK, CMCSA
- Augmented Dicky Fuller Test for cointegration
- Determine hedge ratio by the coefficient of linear regression between CMCSK and CMCSA. Set the hedge ratio to be 0.973068
- The Sharpe Ratio is increased from 0.0881 to 0.4025
- Details listed in folder 'Pairs trading'

2. Result summary



✓ Choose KLAC, LRCX, TXN for dynamic hedging and CMCSK, CMCSA for pair trading

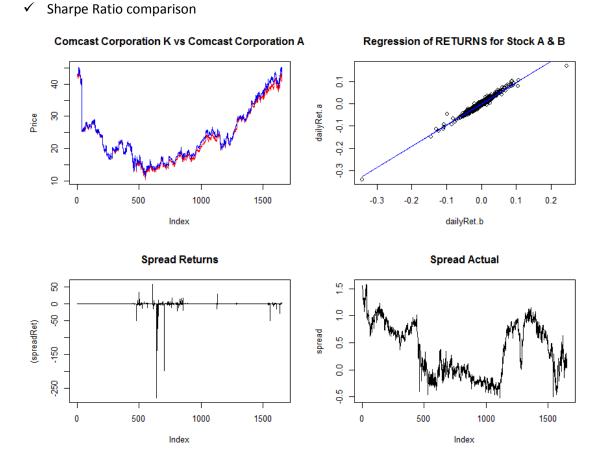


✓ Dynamic hedge ratio plot from 2011-01 to 2014-01 List w1, w2, w3 in R for detailed numbers

invest \$10000 to three stocks equally weighted vs Dynamic hedging

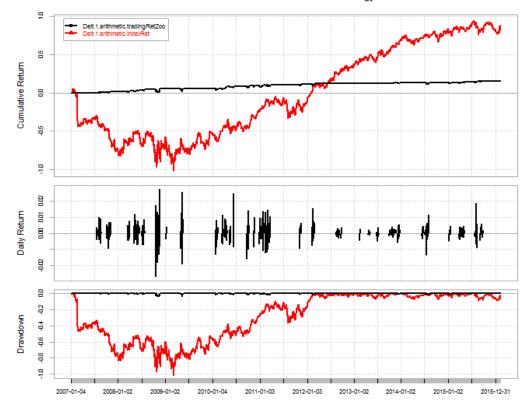
> mean(diff(log(Value)))*252/(sd(diff(log(Value)))*sqrt(252))
[1] 0.06099502

>mean(diff(log(value[!<u>is.na(value)])))*252/(sd(diff(log(value[!is.na(value)])))*sqrt(252))</u>
[1] 0.9539509



✓ CMCSK vs CMCSA cointegration overview





✓ Return comparison of Pair vs simply invest CMCSA

> print(SharpeRatio.annualized(zooTradeVec))
Annualized Sharpe Ratio Pairs CMCSA
(Rf=0%) 0.4025047 0.08813146

✓ Sharpe Ratio comparison

3. Reference

Find correlation:

http://arxiv.org/pdf/1512.03537.pdf

Dynamic hedging:

https://rpubs.com/OmarMa/Equity_Portfolio_Hedging

Pairs trading series:

http://gekkoquant.com/2012/10/21/statistical-arbitrage-correlation-vs-

cointegration/

http://gekkoquant.com/2012/12/17/statistical-arbitrage-testing-for-

cointegration-augmented-dicky-fuller/

http://gekkoquant.com/2013/01/21/statistical-arbitrage-trading-a-

cointegrated-pair/

4. Improvements

- a. The methods of finding optimal hedge ratios and trading strategies are highly sensitive to time. The period chosen to implement the methods is very important. Thus, I am thinking about using predictive models of machine learning to predict future price when finding the perfect stocks to hedge.
- b. If time is allowed, I am considering to apply similar methods to other derivatives or ETFs.
- c. I copied a large chunk of codes from references because the limited time to understand thoroughly about all the theories behind them.
 Codes and methods can be improved in the future after fully understand the concepts.