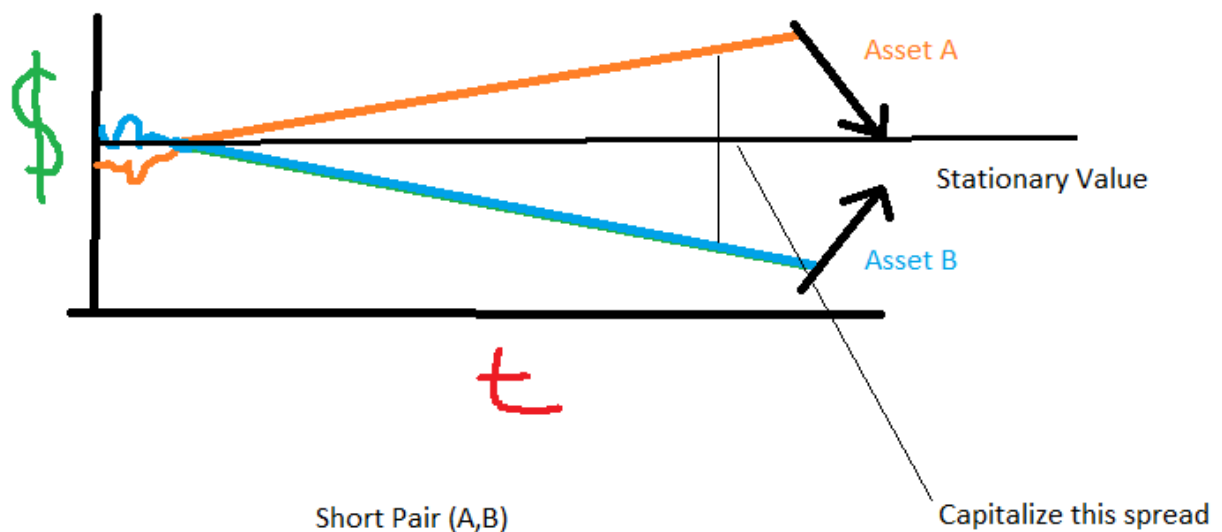# PAIRS TRADING

A pairs trade is a trading strategy that involves matching a long position with a short position in two stocks with a high correlation. A pairs trade strategy is based on the historical correlation of two securities; the securities in a pairs trade must have a high positive correlation, which is the primary driver behind the strategy's profits.

Let's Discuss a hypothetical example to better understand how this strategy works. Say to assets A and B belong to some sector and have historically been highly cointegrated and correlated.

And for some reason the correlation between these stocks reduces for a short period of time. This is when the trader decides to long the underperforming stock A and short stock B simultaneously. Here we long A as we are expecting this asset to rise and we short asset B as a hedge against unfavourable movements. This makes pairs trading a market neutral strategy.


Short Pair (A,B)

CHOOSING A PAIR

The selection process is a pivotal and deanding aspect of the pairs trading strategy. Choosing the right pair is essential for success.

In this algorithm I have created a small universe of 11 stocks in the tech sector.

Then I have created a function to find out the cointegrated pairs inside this universe using p-values.

This is the heatmap of cointegration among the stocks. Since cointegration is observed when p-value is less than 0.05 the pair most suitable for this algorithm would be AMD (Advanced Micro Devices Inc.) and SPY(SPDR® S&P 500® ETF Trust).
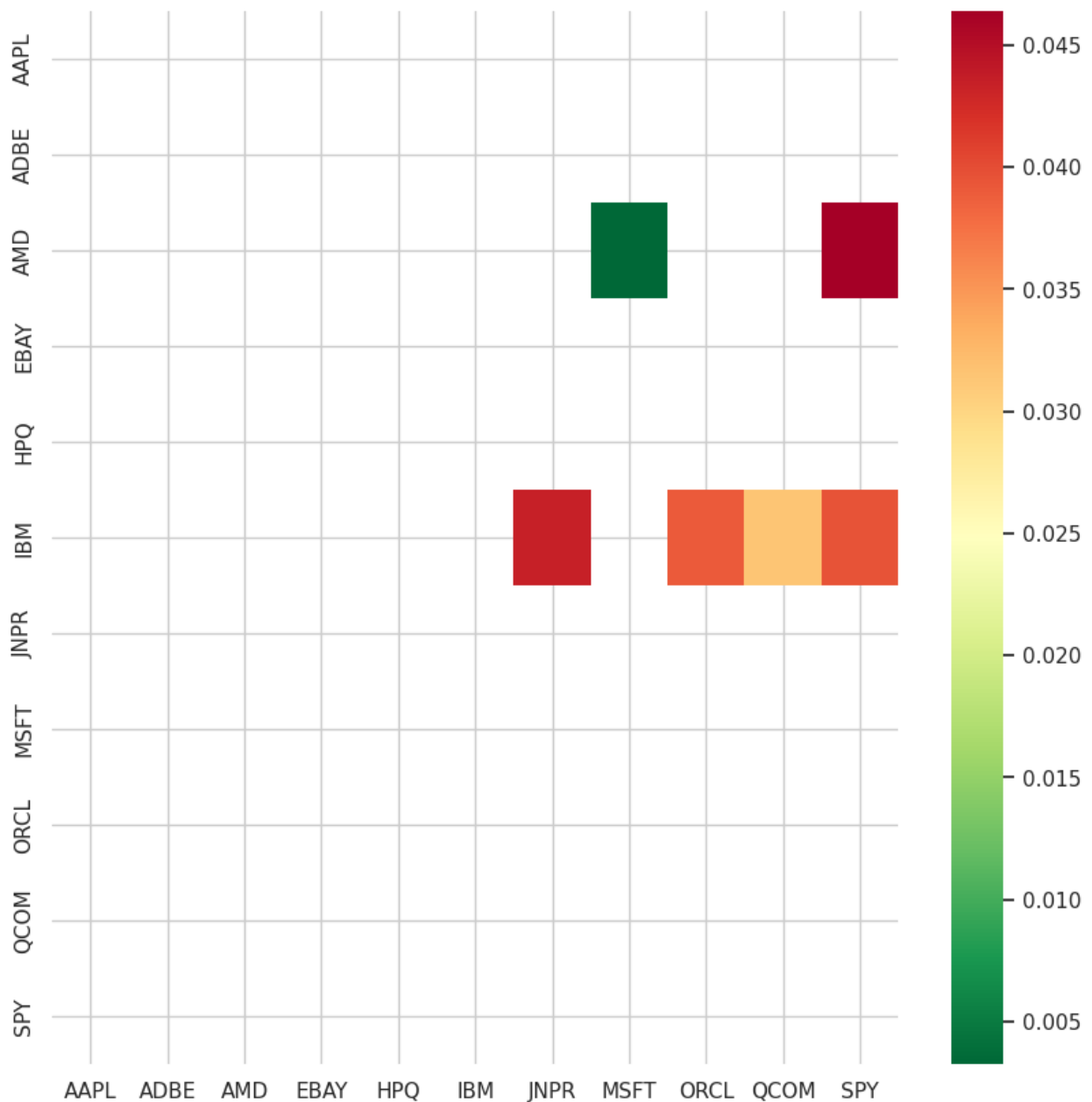
KEY INDICATORS

- **Spread:** In order to actually calculate the spread, we use a linear regression to get the coefficient for the linear combination to construct between our two securities, as mentioned with the Engle-Granger method before.
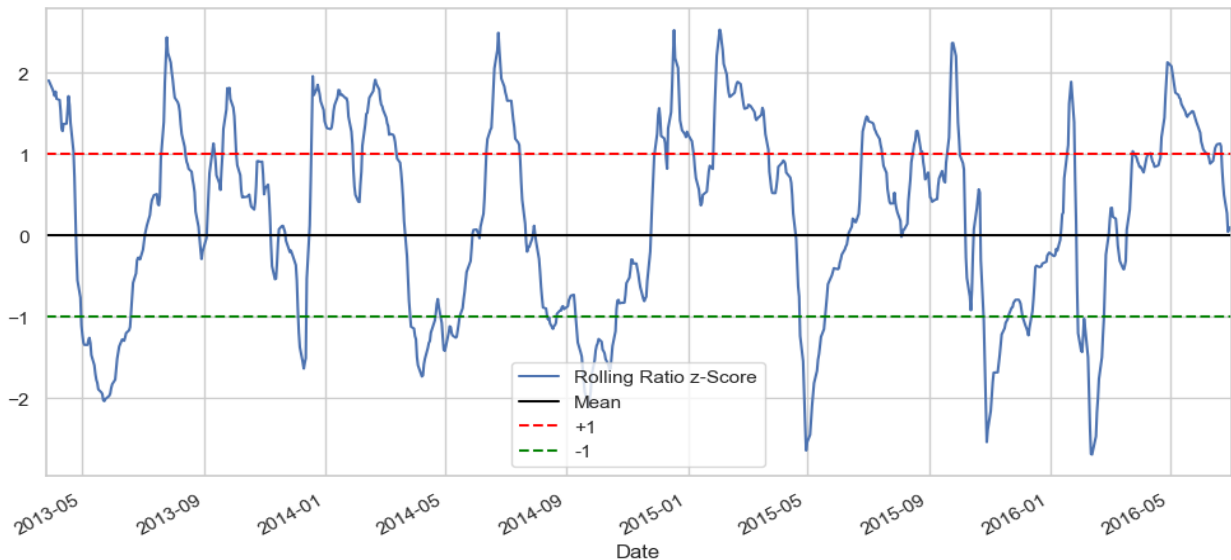

- **Ratio:** Simply the Ratio of the two stock prices.

I have used simple mean reversion on the ratio using 5 day and 60 day moving averages. I have used the Z-score values for 60 days to set my buying and selling conditions.

BUYING AND SELLING CONDITIONS

Now that we've calculated the indicators, we will need to come up with rules to decide when to buy or sell the stock.


A standard normal distribution has a mean of 0 and a standard deviation 1. Looking at the plot, it's pretty clear that if the time series moves 1 standard deviation beyond the mean, it tends to revert back towards the mean. Using these models, we can create the following trading signals:

- Buy(1) whenever the z-score is below -1, meaning we expect the ratio to increase. (Long AMD and Short SPY).
- Sell(-1) whenever the z-score is above 1, meaning we expect the ratio to decrease. (Short AMD and Long SPY)

VISUALIZATION OF SIGNALS
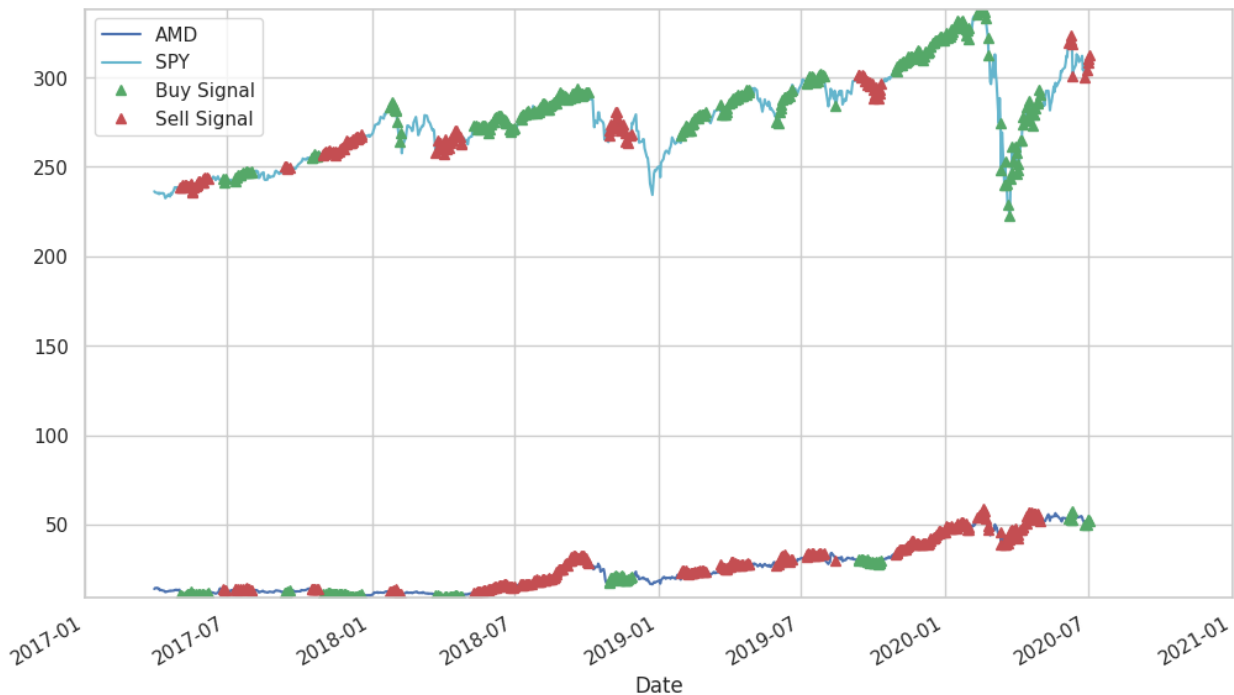
Areas of Improvement and Further Steps

This is by no means a perfect strategy and the implementation of our strategy isn't the best. However, there are several things that can be improved upon.

- **Using more securities and more varied time ranges**
  For the pairs trading strategy cointegration test, I only used a handful of stocks. Naturally (and in practice) it would be more effective to use clusters within an industry. I only use the time range of only 5 years, which may not be representative of stock market volatility.
- **Dealing with overfitting**
  Anything related to data analysis and training models has much to do with the problem of overfitting. There are many different ways to deal with overfitting like validation, such as Kalman filters, and other statistical methods.
- **Adjusting the trading signals**
  Our trading algorithm fails to account for stock prices that overlap and cross each other. Considering that the code only calls for a buy or sell given its ratio, it doesn't take into account which stock is actually higher or lower.

ADVANTAGES

When done right, pairs trading offers many benefits. They include the following:

- Provides a market neutral trading opportunity.
- Minimizes risk due to opposing positions taken.
- Can be executed in different market segments.
- Reduces systematic risk.
- Independent of market trends.

LIMITATIONS

On the flip side, the pairs trading strategy also carries some limitations. They include the following:

- Requires a lot of research and analysis.
- Increases exposure to spread risk.
- Sensitive to market disruptions.
- Unsuccessful for stocks with low liquidity.

CONCLUSION

Pairs trading is often used by quantitative analysts and algorithmic traders due to its reliance on statistical arbitrage and historical patterns rather than directional speculation on the market as a whole. It can be applied to stocks, commodities, currencies, or any other assets with a measurable relationship.

Overall, pairs trading relies on statistical arbitrage and the mean reversion principle. It seeks to capitalize on temporary inefficiencies in the pricing relationship between two assets, rather than making directional bets on the broader market direction. This makes it attractive to quantitative traders and those looking to exploit specific market anomalies.

RESOURCES

- https://www.youtube.com/watch?v=JTucMRYMOyY
- https://www.investopedia.com/terms/p/pairstrade.asp
- https://papers.ssrn.com/sol3/papers.cfm?abstract_id=141615
- https://in.tradingview.com/