Project 5 (Pairs Trading)

Pairs trading is a market neutral trading strategy enabling traders to profit from virtually any market conditions: uptrend, downtrend, or sideways movement. The strategy monitors performance of two historically correlated securities. When the correlation between the two securities temporarily weakens, i.e. one stock moves up while the other moves down, the pairs trade would be to short the outperforming stock and to long the underperforming one, betting that the "spread" between the two would eventually converge. Although this category of strategies can exhibit attractive performance characteristics, as in any quant. strategy, the breadth of bets is proportional to the quality returns. As such, as the creator of a pairs trading strategy, you always prefer more (valid) pairs rather than fewer. In this project, your goal is to find eligible pairs from a large universe of stocks. You can then develop and back-test your own pairs trading strategy.

Data

You are given daily return data of the last 5 years from all stocks in the S&P 500.

Tasks

- Based on the returns, we want to use unsupervised clustering algorithms to build clusters of similarly performing stocks. However, we have too many observations for the clustering algorithms to work efficiently. We first need to reduce the number of components with i.e. PCA. Determine an appropriate number of components and apply the PCA dimensionality reduction.
- Now cluster the stocks based on the reduced components. Which algorithm do you use (e.g DBSCAN, kmeans, ...) and why? How do you calibrate it? Explain.
- Investigate your clusters. Are you content with your clustering process? Can you identify similarities between the constituents? Show an example and explain.
- Within the clusters, find cointegrated pairs of stocks. Investigate and visualize the pairs (T-SNE allows for a 2D visualization of high dimensional data).
- Choose one of the pairs that you found and try to develop a trading strategy based on the spread. For example, use the z-score of the price ratio to determine buy and sell signals:

  Price Ratio (x):
  $$x = \frac{S_1}{S_2}$$
  Z-Score:
  $$z_i = \frac{x_i - \bar{x}}{\sigma}$$
- Backtest your strategy and evaluate. Can you make a profit?

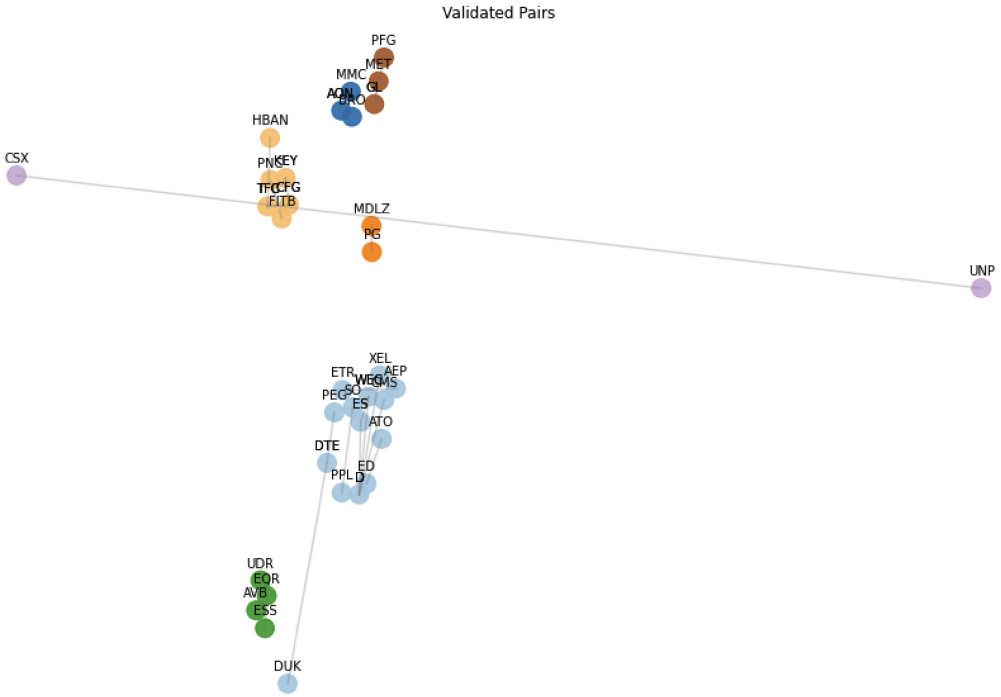

Figure 5: Cointegrated Pairs

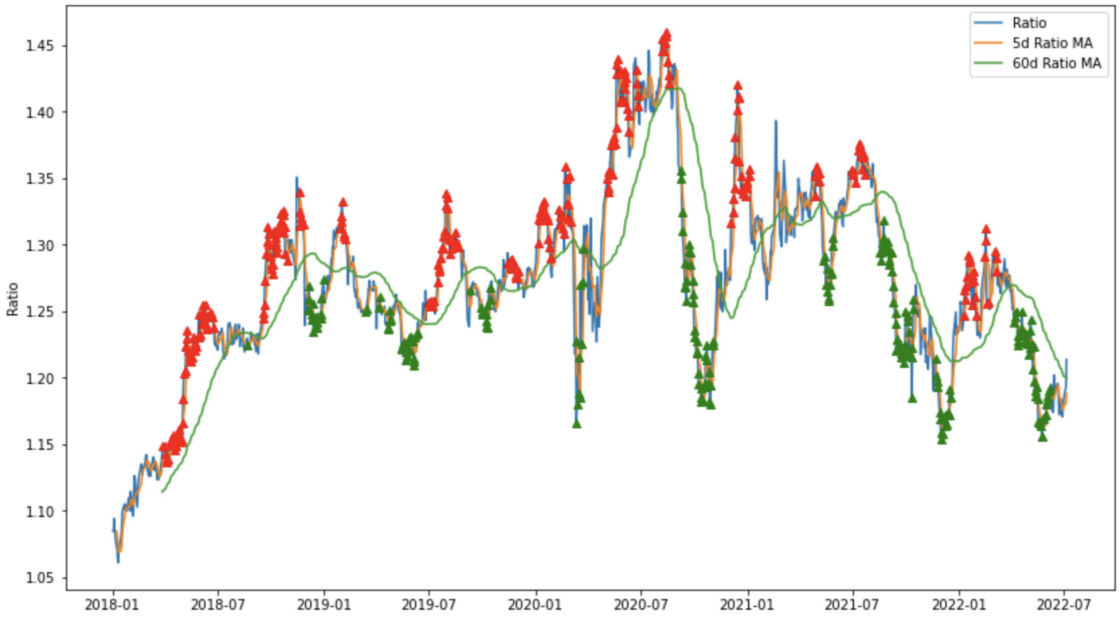

Figure 6: Pairs Trading Strategy Backtest