PANDA and Pairwise Trading

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Introduction

Pairs trading is a market-neutral trading strategy that seeks to leverage price differences between two correlated assets. By identifying the temporary deviations in the prices of assets, traders can potentially generate profits while minimizing exposure to overall market movement. Central to the success of pairs trading is the ability to accurately identify and quantify the strength of the pairings between stocks, both within the same sector and across different sectors.

This strategy is particularly valuable as it allows traders to profit from relative price movements, regardless of the overall market direction. However, the strategy is only as good as the tools used to identify these pairs. Cointegration is one such tool that returns the probability of two stocks moving in the same direction for a time period. However it is limited in the manner that it can only single out two stocks, neglecting the rest of the market where there may be a lot of useful information.

To address these challenges, we propose the application of graph theory and network analysis to enhance the identification of strong pairings between stocks. By representing the financial market as a network, where nodes represent individual stocks and edges represent the relationships between them, we can gain a more holistic and complete view of how stock prices effect each other.

In this research, we explore the adaptation of the Passing Attributes between Networks for Data Assimilation (PANDA) algorithm, originally developed for gene network reconstruction, to the domain of finance. The PANDA algorithm offers a unique approach to integrating multiple datasets and refining predicted interactions between nodes in a network. By leveraging the concepts of effector and affected nodes, along with the notions of responsibility and availability, the algorithm aims to capture the intricate relationships between financial instruments.

Dataset

- We opted to use the QuantConnect platform, provided by UTD's Quantitative Finance Club, in order to test our algorithm and it's application. QuantConnect offers us tools to back test our algorithm, allowing us to utilize years of data without sacrificing the accuracy or applicability of the algorithm.
- For this particular proof of concept, we chose to use finance as our affected sector and technology as our effector sector, although this was somewhat arbitrary and can be applied to any two sectors

Algorithm

- PANDA works as a message passing algorithm, allowing the information presented in multiple networks to be shared between one another, creating more accurate descriptions of what the networks are modeling.
- Three networks were generated, one from finance to itself, one from tech to itself, and one from tech to finance.
- The similarity of weights from stocks to others was encoded as the responsibility and availability matricides.
- The R and A networks are averaged, and the weights are updated
- Similarly, the tech and finance networks are updated with the regulatory and coregulatory matrix generated from the weights
- the process is repeated until the difference between the weights matrix and the next iteration of it converges to

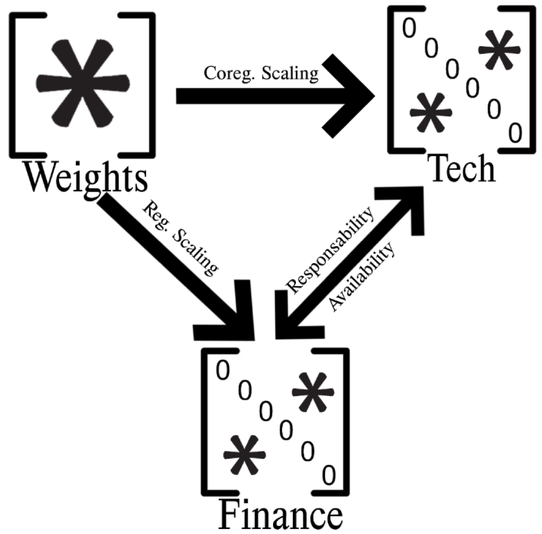

Figure 1. The PANDA Algorithm Network Interaction Model

Methodology and Results

- To test the validity of the PANDA algorithm, we tested it against a simple cointegration test applied to the same set of stocks.
- We define our hypotheses as:

  Hypothesis 1: *The PANDA algorithm outperforms the standard cointegration test*

  Hypothesis 0: *The PANDA algorithm performs worse than or equal to the standard cointegration test*

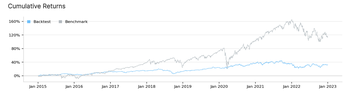

Figure 2. Results of cointegration backtesting

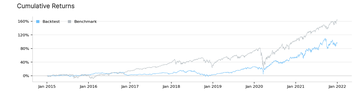

Figure 3. Results of PANDA algorithm backtesting

- In 8 years, the cointegration test achieved cumulative returns of 36.65%, while the PANDA algorithm achieved cumulative returns of 95.11%, outperforming the cointegration test by 58.46%. Thus, hypothesis 1 is accepted.

Conclusion

- This proof of concept will allow for future development and iteration with the algorithm. The value of this exploration was primarily it's novelty, and there are many areas where this can be improved. Finding the movement of certain statistics of stocks, such as EPS or IV could allow a trader to use this algorithm in other strategies, as well as capture the market-network more completely.
- From the mathematical standpoint, we believe that expanding the algorithm to fit multiple networks and sectors will be very valuable, and believe that it is possible to expand the algorithm to fit a more financial paradigm.

References

- Glass, K., Huttenhower, C., Quackenbush, J., Yuan, G.-C. (2013). Passing Messages between Biological Networks to Refine Predicted Interactions. In S. Semsey (Ed.), PLoS ONE (Vol. 8, Issue 5, p. e64832). Public Library of Science (PLoS). https://doi.org/10.1371/journal.pone.0064832