Arbitrage-Type Trade Using Correlation Analysis

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Abstract. The prediction of the stock market was one of the greatest obstacles. Since there are many reserves whose values are extremely unpredictable, good returns from investment must be calculated and determined. We tried our best to address these challenges by picking an index (a collection of stocks in the same sector) and developed an arbitration style trading mechanism in which the leading stock of that index could be chosen by correlation analyzes and technical analyses. When people hear the trade in similarities, they will wonder of arbitrage. And that's why we're dreaming about investing in arbitrage. Although this is not true: arbitrariness is when two entities that are similar or rather connected are out of whack. So, we will look at a stock and its index and they are not identical, so they're never out of whack. There are rules to define the entries and exits in a chosen stock in the trading system. The additional advantage of this method is to forecast the movement of one stock using its relationship with another stock of the same index. Established method is split into two phases: stock correlation and technological analysis. Experiments between July 2017 and June 2020 indicate that the know-how could include an index and its entries and exits.

1. Introduction
Stock Selection is one of the important decision an investor has to take before investing in any sector or individual stock. If the price of stocks changes frequently up and down it definitely affects the peoples life in financially as well as in other aspects. Therefore a need arise to develop forecast methods where accuracy is one of the major concern. Forecasting technique believes that any information which is in public domain like financial status of companies, earnings has a positive relation to the future price of any stock. So, it’s a challenge for investor’s community to find the best method. This paper consists of two phases in phase 1 we will find the correlation of stocks with its index (here we have taken bank nifty) and also we will find correlation among stocks which are of same index and finally in phase 2 we will have look on entries and exits created by our system using correlation and moving average.

2. Related Work
When you're looking at stocks you have two ways to try and predict where stocks prices is going to go and these are two different type of methods, methodologies that you can use are either technical
analysis s or fundamental analysis. Fundamental analysis is when you're evaluating something fundamentally like how many employees do they have what's their tax system their debt expenses all of these are fundamentals. When you're looking at technical analysis, you're only looking price and volume. Both techniques are used in stock markets [1][2]. As fundamental analysis is done by different people analysis and opinion may vary but technical analysis is based on past trend so there in no definite rule to use it. There is a lot of literature available which states that emotions are directly linked [3]. Here they use moving average and classify news on world frequency. As it was concluded in this paper that simple moving technique is more useful as comparison to other complex techniques [4]. The simple moving average method shows the trend using average of prices for a particular duration [5][6]. It is generally a closing price of each day which removes the noises and getting trend movement is easier. For getting the trend using moving average one can calculate two moving average for different duration like short term and long-term moving average. While comparing if it is seen that short term average is greater than long term average then it is an indication price will go up [7][8].

Malhotra & Tandon (2013). They determine and show various factors which can affect the share price are like eps, book value, p/e ratio. For this they have taken a sample of 95 companies and concluded that all these factors have positive impact [9][10]. Various researchers have found important internal factors that determine the share prices for different markets, viz., dividend, retained earnings, size, earnings per share, dividend yield, leverage, payout ratio, and book value per share [11][12].

3. System Architecture

![Diagram of System Architecture](image)

**Figure 1.** The Architecture of Trading System to find and Select the Leader Stock of An Index

Fig. 1 demonstrates the fundamental architecture of the expert method. The trading mechanism established consists of five key components. Each component has the following function [13][14][15]:

- The user interface is the interface used to share information between an investor and the device.
• Evaluate and view the interface engine and description functions automatically. Investors may opt to buy or sell stocks by using this detail.
• Knowledge base is a core component that defines device consistency. This is demonstrated by domain engineer rules that gather and summarize the applicable expertise and information from domain experts.
• Stock archive is compared to historical inventory records from which studies are carried out by domain engineers.
• After evaluating database data, Adjuster tunes the knowledge. Regular information tuning is required in a complex situation.

4. Methodology
When one sees a leading index stock to forecast the potential price movement, one must first look at the index or sector in which one wants to invest through business analysis and economic analytical analysis. The relationship between the observed index and its components of stocks is then analyzed. The stocks with the highest index correlation are derived from the data analyzed. Secondly, all stocks in the index are associated with the index's most correlated portfolio. This is the value of this method since it is the other means of approaching any stock in an index using the most associated stock in that index [16][17].
Finally, if the stock and index are closely correlated, technical analysis would be needed. In this step the 50-day exponential moving average is collected in order to consider the exponential moving average association of inventory and index. The analyzed discrepancy in the exponential moving stock average and their index is then merged with the exponential moving stock average to include rules for entries and exits [18][19].

**Figure 2.** Rules for LONG positions

```
Go LONG if :
EMA_Diff_Slow > 0
AND EMA_Diff_Fast > 0
AND NSEBANK_movement > 0
AND AXISBANK.NS_movement > 0
AND (AXISBANK.NS_movement - NSEBANK_movement) < 0
AND (AXISBANK.NS_movement - NSEBANK_movement) > -0.04

Exit LONG if :
EMAI_Diff_Fast < 0
AND NSEBANK_movement < 0
AND AXISBANK.NS_movement < 0
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**Figure 3.** Rules for SHORT Positions

```
Go SHORT if :
EMA_Diff_Slow < 0
AND EMA_Diff_Fast < 0
AND NSEBANK_movement < 0
AND AXISBANK.NS_movement < 0
AND (AXISBANK.NS_movement - NSEBANK_movement) > 0
AND (AXISBANK.NS_movement - NSEBANK_movement) < 0.04

Exit SHORT if :
EMA_Diff_Fast > 0
AND NSEBANK_movement > 0
AND AXISBANK.NS_movement > 0
```

Figure 2 and 3 show how defined rules are constructed. Both rules have reserved words such as EMA_Diff_Slow, EMA_Diff_Fast, NSEBANK_movement, and AXISBANK.NS_movement. If the input data are matched with “IF conditions” then the trade is identified by the conditions. EMA_Diff_Slow is the difference between medium EMA (100-days) and slow EMA (200-days)
whereas EMA_Diff_Fast is the difference between fast EMA (20-days) and medium EMA (100-days). The default settings of moving averages are taken by our system though it can be changed according to one’s suitability. NSEBANK_movement and AXISBANK.NS_movement are 50-days exponential moving averages for the difference of their previous close and current close respectively [20][21][22].

5. Experimental Results
The trading system for selecting and determining trades is implemented through R programming tool, R libraries such as quantmod and ttr etc. It can do statistical computing among data, design them efficiently, implement the user interface easily and reuse the codes proficiently. The experimental dataset used in this study covers the period from July 2017 to June 2020. From all the listings in the stock market, Nifty Bank (Index) and its five heavy weighted stocks, namely, HDFC bank (28.83%), ICICI bank (19.61%), Kotak Mahindra bank (14.89%), Axis bank (14.36%) and State bank of India (10.44%) were selected at random. Throughout the three years of data, the usefulness of defined rules were proven. The test database is a series of code, a date, a closing price, as well as up and down trends of the stock and its index.

Table 1. The Figure Showing Correlation of Stocks with its Index

| X1        | NSEBANK.Close |
|-----------|---------------|
| HDFCBANK.NS.Close | 0.86          |
| ICICIBANK.NS.Close | 0.71          |
| KOTAKBANK.NS.Close | 0.68          |
| AXISBANK.NS.Close | 0.94          |
| SBIN.NS.Close    | 0.84          |
| NSEBANK.Close    | 1             |

Table 1 shows the correlation between the index (NSEBANK) and its stocks. The average correlation of experimented stocks is about 0.80. It indicates that high returns can be obtained from trades or investments according to developed rules for entries and exits. Even though there are 12 stocks in Nifty bank, only five stocks were elicited and formalized through the knowledge acquisition [23].

Table 2. Represents the Correlation of Most Correlated Stock of an Index with other Stocks in the Same Index

| X1         | HDFCBANK.NS.Close | ICICIBANK.NS.Close | KOTAKBANK.NS.Close | AXISBANK.NS.Close | SBIN.NS.Close | NSEBANK.Close |
|------------|-------------------|-------------------|-------------------|------------------|---------------|---------------|
| HDFCBANK.NS.Close | 1                 | 0.86              | 0.93              | 0.84             | 0.53          | 0.86          |
| ICICIBANK.NS.Close | 0.86              | 1                 | 0.85              | 0.74             | 0.45          | 0.71          |
| KOTAKBANK.NS.Close | 0.93              | 0.86              | 1                 | 0.66             | 0.29          | 0.68          |
| AXISBANK.NS.Close | 0.84              | 0.74              | 0.66              | 1                | 0.78          | 0.94          |
| SBIN.NS.Close    | 0.53              | 0.46              | 0.29              | 0.78             | 1             | 0.84          |
| NSEBANK.Close    | 0.86              | 0.71              | 0.68              | 0.94             | 0.84          | 1             |

Table 2 represents the correlation among stocks of an index. This is the benefit of this system as it can be another approach of selecting a stock. It is observed that correlation of another stock with the most correlated stock of an index can also give a good trade. Our trading system has plotted the price movements of all the selected stocks and index to show the most correlated stock as shown in fig. 4 and 5. Hence, our further experiment of phase 2 has been done on the most correlated stock only [24].
In our analysis, AXIS bank is the index's most correlated holding, with a correlation to Nifty Bank of 0.94. The price changes of Axis bank and Nifty bank were also obtained in a single plot to observe price movement and also the association as seen in fig. 6.
Figure 6. Price movement and correlation of AXIS Bank and NSE Bank

Trends are also an important aspect of this analysis. As seen in figure, the 50-day exponential averages are shown for the discrepancy between the closure of Axis Bank and Nifty Bank respectively in fig. 7. The disparity between these moving averages is also seen in comparison with the average moving average EMA diff slow of the axis bank shown in fig.8.

Figure 7. Moving Averages to obtain the trend of AXISBANK and NSEBANK

Figure 8. EMA difference of AXIS Bank and NSE Bank along with EMA_diff_slow
As it is found that Axis Bank is Nifty Bank's most correlated stock. We attempted to add various changing averages to this stock's price trend. In order to obtain the EMA Diff Fast (Fast EMA – Rapid EMA) and EMA Diff slow (Medium EMA – Slow EMA) for some form of technical analyzes for entry and exit as seen in Fig.11, quick movement average (20-days), medium motion average (100-days) and slow motion average (200-days) are used in fig. 9.

![Figure 9. AXIS Bank Chart with EMA_Diff_slow and EMA_Diff_fast](image)

This research not only picks and forecasts every movement of inventories out of thousands, it also informs us about the index or market. Finally, add rules in figs as described. 2 and 3 are some nice lengths and shorts as seen in fig. 10 where blue diamonds are LONG and red diamonds are recommended to go SHORT.

![Figure 10. Trading Signals on the AXIS Bank Chart](image)

### 6. Discussion

The test results sum up the relationship between a single industrial sector and the direction of stock prices. The key explanation for field-related role of the established rules is that potential price fluctuations can also be measured by field-related knowledge, and not only by the stock price. This is the different path to good stock investing. There are two issues in the allocation of stocks based on the study of similarity. Firstly, since there are many other stocks not available in the index, it will minimize our stock market prospects. Secondly, this study prioritizes the highest correlated stock and
this system somewhat excludes stocks with poor index correlation. The bursary world is evolving dynamically, existing information can no longer be helpful. Therefore, information must be continually improved in order to preserve its utility in a complex situation.

7. Conclusion and Future Scope

In this analysis, we have built a trading method for arbitration based on correlation and technical analysis to decide the time of entry and exit from a stock. For the obtainment of good trade, mathematical computation is used and the knowledge base is established by certain laws to forecast the stock price movement that can award such good trades. The trading method built however has a drawback – the absence of machine learning algorithms. Embedded systems will improve the system's predictive power through advanced learning algorithms. In the end, more study is proposed to develop an integrated trading system to combine technical analysis and tools and indicators.

8. References

[1] D. Olson and C. Mossman, “Neural network forecasts of Canadian stock returns using accounting ratios”, International Journal of Forecasting, 2003, vol. 19(3), pp. 453-465.

[2] T. Kimoto, K. Asakawa, M. Yoda, and M. Takeoka, “Stock market prediction system with modular neural networks”, IJCNN International Joint Conference on Neural Networks, 1990, vol. 1, pp. 1-6.

[3] L. Ertuna, “Stock Market Prediction Using Neural Network Time Series Forecasting,” May 2016

[4] X. Tang, C. Yang, J. Zhou, “Stock price forecasting by combining news mining and time series analysis”, 2009, IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology - Workshop

[5] Investopedia US, A Division of IAC, Investopedia – Educating the world about finance, 2014.

[6] Almumani, M. A. (2014). Determinants of equity share prices of the listed banks in Amman stock exchange: Quantitative approach. International Journal of Business and Social Science, 5(1), 91-104.

[7] Adebisi, O. S., & Lawal, K. O. (2015). Equity share price determinants: a survey of literature. Arabian Journal of Business and Management Review (Oman Chapter), 5(3), 38.

[8] Xu, L.D., et al., Internet of Things in industry: a survey. IEEE Trans. Ind. Inf. 10(4), 2233–2243 (2014)

[9] Pujari, J.D., et al.: Image processing-based detection of Fungai diseases in plants. Proc. Comput. Sci. 46, 1802–1808 (2015). ISSN: 1877-0509

[10] Ngu, A.H., Gutierrez, M., Metsis, V., Nepal, S., Sheng, Q.Z., IoT middleware: a survey on issues and enabling technologies. IEEE Int. Things J. 4(1), 1–20 (2017)

[11] Liu, C.H., Yang, B., Liu, T., Efficient naming, addressing and profile services in Internet of Things sensory envirnoments. Ad Hoc Netw. 18, 85–101 (2014)

[12] Atzori, L., Lera, A., Morabito, G., The Internet of Things: a survey. Comput. Netw. 54(15), 2787–2805 (2010)

[13] Yan-e, D., Design of intelligent agriculture management information system based on IoT. In: 2011 Fourth International Conference on Intelligent Computation Technology and Automation, vol. 1, pp. 1045–1049, Mar 2011

[14] Fang, S., Da Xu, L., Zhu, Y., Ahati, J., Pei, H., Yan, J., Liu, Z., An integrated system for regional environmental monitoring and management based on Internet of Things. IEEE Trans. Ind. Inf. 10(2), 1596–1605 (2014)

[15] Dursun, M., Ozden, S.A., A wireless application of drip irrigation automation supported by soil moisture sensors. Sci. Res. Essays 6, 1573–1582 (2011)
[16] Khattab, A., Abdelgawad, A., Yelmarthi, K., Design and implementation of a cloud-based IoT scheme for precision agriculture. In: 28th International Conference on Microelectronics, pp. 201–204 (2016)

[17] Kodali, R.K., Sahu, A., AnIoT based weather information prototype using WeMos. In: 2nd International Conference on Contemporary Computing and Informatics, pp. 612–616 (2013)

[18] Bing, F.: The research of IOT of agriculture based on three layers architecture. In: 2nd International Conference on Cloud Computing and Internet of Things, pp. 162–165 (2016)

[19] Edwards-Murphy, F., Magno, M., Whelan, P.M., O’Halloran, J., Popovici, E.M., B+WSN: smart beehive with preliminary decision tree analysis for agriculture and honey bee health monitoring. Comput. Electron. Agric. 124, 211–219 (2016). https://doi.org/10.1016/j.compag.2016.04.008

[20] Ankit Kumar, Pankaj Dadheech, Vijander Singh, Linesh Raja & Ramesh C. Poonia (2019), “An Enhanced Quantum Key Distribution Protocol for Security Authentication”, Journal of Discrete Mathematical Sciences and Cryptography, 22:4, 499-507, DOI: 10.1080/09720529.2019.1637154.

[21] Ankit Kumar, Pankaj Dadheech, Vijander Singh, Ramesh C. Poonia & Linesh Raja (2019), “An Improved Quantum Key Distribution Protocol for Verification”, Journal of Discrete Mathematical Sciences and Cryptography, 22:4, 491-498, DOI: 10.1080/09720529.2019.1637153.

[22] Ankit Kumar, Linesh Raja, Pankaj Dadheech, Manish Bhardwaj (2020), “A Hybrid Cluster Technique for Improving the Efficiency of Colour Image Segmentation”, World Review of Entrepreneurship, Management and Sustainable Development, Nov. 2020, Vol. 16, Issue 6, pp. 665-679, Print ISSN: 1746-0573 Online ISSN: 1746-0581, https://doi.org/10.1504/WREMSD.2020.111405.

[23] Pankaj Dadheech, Ankit Kumar, Vijander Singh, Linesh Raja, Ramesh Poonia (2020), A Neural Network-Based Approach for Pest Detection and Control in Modern Agriculture Using Internet of Things. In: Amit Kumar Gupta, Dinesh Goyal, Vijander Singh, Harish Sharma (eds), Smart Agricultural Services Using Deep Learning, Big Data, and IoT, October, 2020, pp 1-19, ISBN13: 9781799850038, ISBN10: 179985003X, EISBN13: 9781799850045, DOI: 10.4018/978-1-7998-5003-8.ch001, Publisher IGI Global.

[24] Ankit Kumar, Pankaj Dadheech, Vijander Singh, Linesh Raja (2020), “Performance Modeling for Secure Migration Processes of Legacy Systems to the Cloud Computing”, In: Tin TheinThwet, G. R. Sinha (eds), "Data Deduplication Approaches: Concepts, Strategies and Challenges", Chapter-13, pp. 255–280, ISBN: 978-0-12-823395-5, DOI: https://doi.org/10.1016/B978-0-12-823395-5.00003-3, Publisher Elsevier.