



State-of-the-Art in Stock Prediction Techniques

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ABSTRACT: Stock markets are affected by many uncertainties and interrelated economic and political factors at both local and global levels. The key to successful stock market forecasting is achieving best results with minimum required input data. To determine the set of relevant factors for making accurate predictions is a complicated task and so regular stock market analysis is very essential. More specifically, the stock market's movements are analyzed and predicted in order to retrieve knowledge that could guide investors on when to buy and sell. It will also help the investor to make money through his investment in the stock market. This paper surveys large number of resources from research papers, web-sources, company reports and other available sources.

Keywords: Stock Market, prediction, technical analysis, fundamental analysis, literature survey.

I. INTRODUCTION

The Indian stock exchanges globally hold a place of prominence. The Bombay Stock Exchange (BSE) is one of the oldest exchanges across the world, while the National Stock Exchange (NSE) is among the best in terms of sophistication and advancement of technology. Investment in stock market is regarded as high risks and high gains and so attracts large number of investors and economists. However, information regarding a stock is normally incomplete, complex, uncertain and vague, making it a challenge to predict the future economic performance. People invest in the stock market based on some analysis. Before the computer age, people use to do trading in stocks and commodities based on their gut feelings. As the level of investing and trading grew, people searched for tools and methods that would increase their gains while minimizing their risk [1]. Globally, trading in the stock market has gained huge popularity and it becomes the part of daily routine for many people to reap handsome profits. However, the prediction of stock price movement becomes a challenge because of the complexity of the stock market data. Though analyzing stock movement behavior is a challenging task, the robust predictive modeling can guide an investor in identifying and segmenting high performance securities, so as to take the superior investment decisions. Statistics, technical analysis, fundamental analysis, and linear regression are all used to attempt to predict and benefit from the market's direction. None of these techniques has proven to be the consistently correct prediction tool. Also, many of these techniques are used to pre-process raw data inputs, and their results are fed into neural networks as input. The central idea to successful stock market prediction is achieving best results using minimum required input data and the least complex stock market model. Recent advances in soft computing techniques offer useful tool for analyzing the stock market's movement and the movement of individual stock prices to retrieve knowledge that may guide investors on when to buy and sell [2].

With the cross border movements of capital like never before in the form of FDI and FII, coupled with the easing of restrictions bringing various stock exchanges at par in terms of system and regulations, it can be assumed reasonably that a particular stock exchange will have some impact on other exchanges. The main objective of this study is to capture the trends, similarities and patterns in the activities and movements of the Indian Stock Market in comparison to its international counterparts. The aim is to help the investors understand the impact of important happenings on the Indian Stock exchange. This is especially relevant in the current scenario when the financial markets across the globe are getting integrated into one big market by considering the impact of one exchange on the other exchanges. Financial securities are generally analyzed and evaluated by two methods. These are fundamental analysis and the technical analysis.

The objective of this paper is to study the existing methods for prediction of Indian stock market and discuss related parameter. Various advantages and limitations of these methods are also discussed. Additionally, a comprehensive review of significant developments in the field of Indian stock market prediction is presented.

The rest of the paper is organized as follows. The section II discusses the analysis of stock prediction based on fundamental analysis. Section III describes the analysis of stock prediction based on technical analysis. Section IV elaborates the significant work done in the field of stock prediction. In section V various existing methods with their



advantages and limitations are discussed so as to formulate the problem and its expected solutions. Conclusive remarks in the respect of Indian stock market prediction are given in section VI.

II. FUNDAMENTAL ANALYSIS BASED STOCK PREDICTION

A. Introduction to fundamental Analysis

The fundamental analysis involves the in-depth analysis of a company's performance and the profitability to measure its intrinsic value by studying the company physically in terms of its product sales, man power quality, infrastructure, profitability on investment. It uses revenues, earnings, future growth, return on equity, profit margins, and other data to determine a company's underlying value and potential for future growth.

To a fundamentalist, the market price of a stock tends to move towards its "real value" or "intrinsic value". If this value of a stock is above the current market price, the investor can decide to purchase the stock because the stock price will bound to rise and move towards its "intrinsic or real value". If this value of a stock is below the market price, the investor may decide to sell the stock because the stock price is bound to fall and come closer to its intrinsic value. To start finding out the intrinsic value, the fundamentalist analyzer makes an examination of the current and future overall health of the economy as a whole.

B. Assumptions of fundamental analysis

- Stock price (current and future) depends on its intrinsic value and can anticipate return on investment.
- Investors are 90% logical, examining their investments in detail.

C. The advantages of fundamental analysis

- The advantages of fundamental analysis are its systematic approach and its ability to predict changes before they show up on the charts.
- Fundamental analysis is a superior method for long-term stability and growth.

D. Disadvantages of fundamental analysis

- It becomes harder to formalize all this knowledge for purposes of automation (with a neural network for example), and interpretation of this knowledge may be subjective.
- It is hard to time the market using fundamental analysis.

E. Important Ratios for fundamental analysis

The concept of stock valuation can be understood mainly by knowing some ratios. None of the valuation discussed below are superior to each other. Each of them has their own importance. Any share which does not reflect all these parameters as healthy means it is not a good buy.

- **The Price-to-Book Ratio (P/B):** Book value is that value of a company, which the owner is likely to gather if they decide to liquidate (sell off in dire straits) the company.
- **Price-to-Earnings Ratio (P/E):** P/E Ratio compares the market price with the EPS. Where, EPS (Earning per share) is the company's net earnings by the numbers of outstanding shares of the stock. Higher the P/E ratio, more people are convinced to pay high for that share expecting higher growth in coming future.
- **The PEG Ratio:** The PEG ratio is the P/E ratio of a company by the year-on-year growth rate of its earnings. The lower the value of your PEG ratio, the better the deal you're getting for the stock's future estimated earnings.
- **Dividend Yield:** The dividend yield shows how much payout you're getting for your money. It is the stock's annual dividend payout by the stock's price.
- **Debt to Equity Ratio:** This should not be more than 1, and less than 1 indicates company has very less debt. This is very important during market down trend as company has to pay lots of interest beside low profitability. So it is a good sign, if company has less debt to Equity Ratio.
- **Returns on Equity (ROE):** It is used as a general indication of the company's efficiency, in other words, how much profit it is able to generate given the resources provided by its stockholders. Investors usually look for companies with ROE that are high and growing.

No Element Stands Alone. P/B, P/E, PEG, Dividend Yield, Debt to Equity Ratio is too narrowly focused to stand alone as a single measure of a stock. By combining these methods of valuation, you can get a better view of a stock's worth.

III. TECHNICAL ANALYSIS BASED STOCK PREDICTION

A. Introduction to Technical Analysis

Technical analysis is a method of evaluating stocks by analyzing statistics generated by market activity, past prices, and volume. It looks for peaks, bottoms, trends, patterns, and other factors affecting a stock's price movement. Future



values of stock prices often depend on their past values and the past values of other correlated variables. Technical analysis looks for patterns and indicators on stock charts that will determine a stock's future performance [3].

However, it is used by approximately 90% of the major stock traders. Despite its widespread use, technical analysis is criticized because it is highly subjective. Different individuals can interpret charts in different manners.

Recently, neural networks have been successfully applied in time-series problems to improve multivariate prediction ability. Neural networks have good generalization capabilities by mapping input values and output values of given patterns. Neural networks are usually robust against noisy or missing data, all of which are highly desirable properties in time series prediction problems. Various neural network models have already been developed for the stock market analysis.

B. Assumptions of technical analysis

Market moves in trends dictated by the constantly changing attitudes of investors in response to different forces.

History repeats itself i.e. under similar kinds of inputs the stock behaves in similar manner.

Prices have tendency to go with the trend rather than against it.

Investors are 90% psychological, reacting to changes in the market environment in predictable ways.

C. The advantages of technical analysis

- It is used by approximately 90% of the major stock traders.
- It is also used to analyze the stock for shorter period.

D. Disadvantages of technical analysis

- Despite its widespread use, technical analysis is criticized because it is highly subjective.
- Different individuals can interpret charts in different manners.

E. Important Parameters for technical analysis

In technical analysis of stock market data 52 different parameters, indicators and oscillators have been defined. Even though each indicator provides some additional information about the stock, using each one of them will make the system complex and slow. This would require at least 2^{52} rules for the ANFIS structure. Hence there is a need to identify the parameters (feature vectors of the financial data) that most closely predict the nature of the movement without increasing the system complexity [4], [5].

- **Moving Average (MA):** This is perhaps the oldest and the most widely used technical indicator. It shows the average value of stock price over time. The shorter the time period, the more reactionary a moving average becomes. A typical short term moving average ranges from 5 to 25 days, an intermediate-term from 5 to 100, and long-term 100 to 250 days.
- **Exponential Moving Average (EMA):** An exponential moving average gives more weight to recent prices, and is calculated by applying a percentage of today's closing price to yesterday's moving average. The longer the period of the exponential moving average, the less total weight is applied to the most recent price. The advantage to an exponential average is its ability to pick up on price changes more.
- **Moving Average Convergence/Divergence (MACD):** It is the difference between two exponential moving averages, normally one short moving average and one long moving average.
- **Relative Strength Index (RSI):** An oscillator, introduced by J. Welles Wilder, Jr., is based upon the difference between the average gains vs. the average loss over a given period. The RSI compares the magnitude of a stock's recent gains to the magnitude of its recent losses.

IV. SIGNIFICANT DEVELOPMENT IN THE FIELD OF STOCK PREDICTION

Arun Upadhyay et al. (2012) developed Multinomial Logistic Regression (MLR) model to predict the outperforming stock. Author used financial ratios as usable selection criteria for determining performance in the stock market based on the stock return comparing with market return. The model was tested on 30 large market capitalization companies ratio over the period of four years. The classification results showed high predictive accuracy rates of 56.8%. The author concludes that the developed model can enhance an investor's stock price forecasting ability [1].

K.K. Sureshkumaret et al. (2011) used prediction algorithms and functions to predict future share prices and compares their performance. The results from analysis showed that used isotonic regression function offers the ability to predict the stock prices more accurately than the other existing techniques [2].

Mohsen Mehraraet et al. (2010) used Multi-Layered Feed Forward (MLFF) neural network with back-propagation learning algorithm and Group Method of Data Handling (GMDH) neural network with Genetic algorithm (GA) learning to predict TSE (Taiwan Stock Exchange) database. The paper used moving average crossover inputs based on technical analysis rules and the results showed the exponential moving average has better result than simple moving



average and also the GMDH had better result in the forecasting, power tracking and profitability relative to MLFF neural network [3].

Agrawal et al. (2010) presented an innovative approach for indicating stock market decisions by minimizing the risk involved in making investments. The system used Adaptive Neuro-Fuzzy Inference System (ANFIS) for taking decisions based on technical indicators. Among the various technical indicators available, the system used weighted moving averages, divergence and RSI (Relative Strength Index) [4].

Manna Majumder et al. (2010) presented a neural network based computational approach for predicting the direction of movement of the S&P CNX Nifty 50 Index. The proposed model has used the pre-processed data set of closing value of S&P CNX Nifty 50 Index from 1st January, 2000 to 31st December, 2009. The model gave highest performance of 89.65% in terms of accuracy in predicting the direction of the closing value of the index and an average accuracy of 69.72% over a period of 4 years [5].

Amit Ganatret et al. (2010) focused to build neural network for stock market prediction. Author used R tool to implement the neural network with closing price, turnover, global indices, interest rate, and inflation as a neural network input. Author also proposed to include other indicator like news, currency rate, and crude price as input to the neural network. Subsequently, an attempt was made to build and evaluate a neural network with different network parameters and also with technical and fundamental data. In benchmark comparisons they found that the price prediction proves to be successful [6].

M. M. Goswami et al. (2009) proposed a novel model that tries to predict short term price fluctuation, using Candlestick Analysis. The proposed approach combines Self Organizing Map with Case Based Reasoning to identify profitable patterns (candlestick) and predicts stock price fluctuation based on the pattern consequences [7].

Saiful Hafizah Jaaman et al. (2009) analyzed and predicted the stock market movements in order to retrieve knowledge that could guide investors on when to buy and sell. Author found that the ability of rough set approach to discover dependencies in data while eliminating superfluous factors in noisy stock market data deems very useful to extract trading rules. He further explained how the detecting market timing was crucial to capture the major turning points in data and also discussed the inability of the developed predictive system to detect numerous minor trends displayed by volatile individual firms [8].

George S. Atsalakis et al. (2008) surveyed more than 100 related published articles that focus on neural and neuro-fuzzy techniques to forecast stock markets. The surveyed papers showed that the soft computing techniques were widely accepted for studying and evaluating stock market behavior. Classifications were made in terms of input data, forecasting methodology, and performance evaluation. They have concluded that in view of stock market model uncertainty, soft computing techniques were viable candidates to capture stock market nonlinear relations returning significant forecasting results with not necessarily prior knowledge of input data statistical distributions [9].

S. Chaigusinet et al. (2008) analyzed relevant literature on the Stock Exchange of Thailand (SET), according to the categories of techniques used and on the basis of that they proposed an approach of soft computing on the SET forecasting and exposed the main driving indicators. They have also tested their approach to Dow Jones, Nikkei index, HangSeng index, Minimum Loan Rate, the value of the Thai baht and the gold price [10].

M. Thenmozhi (2006) has applied neural network to predict the daily returns of the BSE. Multilayer perceptron network was used to build the daily return's model and the network was trained using Error Back Propagation algorithm. The author found that the predictive power of the network model was influenced by the previous day's return than the first three-day's inputs. The study showed that satisfactory results can be achieved when applying neural networks to predict the BSE Sensex [11].

Xiaoping Yang (2005) combined the different models and examples to study how the factors affect stock prices. He used the principal component analysis to reduce the number of variables by keeping most of the information of original variables. Then, the BP Neural Network was established to analyze and predict stock prices. Finally, the method was tested on the Chinese stock market and found that the predicting of stock prices using this method is satisfying and feasible [12].

Myungsook Klassen (2005) explained the need to select a large volume data to keep the dimensionality of input vectors small. Technical indexes commonly used for stock market prediction using neural networks are investigated to determine its effectiveness as inputs. The feed forward neural network of Levenberg-Marquardt algorithm was applied to perform one step ahead forecasting of NASDAQ and Dow stock prices [13].

Mohamed Aly et al. () proposed a method which uses the fusion of predictors to improve the performance of chaotic time series prediction. Different nonlinear predictors with distinct characteristics including the multi-layer perceptron neural network, radial basis function (RBF) neural network, fuzzy inference system, recurrent neural network, Volterra filter, and local linear predictor were used to predict a chaotic time series. Their predictions were then combined to produce a more accurate prediction by using the linearly constrained least square (LCLS) fusion method. The proposed



prediction fusion method was evaluated using simulated chaotic time series based on the Mackey-Glass equation and Ikeda system. Results showed that the fused predictor consistently outperforms all the individual predictors [14].

Yuehui Chen et al. () investigated how the seemingly chaotic behavior of stock markets could be well represented using neural network, TS fuzzy system and hierarchical TS fuzzy techniques. To demonstrate the different techniques, author analyzed 7 year's Nasdaq 100 main index values and 4 year's NIFTY index values. He has used particle swarm optimization algorithm to optimize the parameters of the different techniques. This paper briefly explained how the different learning paradigms could be formulated using various methods and then investigated whether they can provide the required level of performance, which were sufficiently good and robust so as to provide a reliable forecast model for stock market indices. Experiment results revealed that all the models considered could represent the stock indices behavior very accurately [15].

Mohammad Mojaddady et al. () considered the Twin Gaussian Process (TGP) method to predict the stock prices. They have used the historical data of stock price to learn TGP and established the relation between input and output data. Then, by inserting the new data to TGP, they have predicted the stock prices. The method was also tested on both USA and Iran stocks and found that the results of using TGP method was much effective than the other available base line methods [16].

Wei Huang et al. (2004) investigated the predictability of financial movement direction with Support vector machine (SVM) by forecasting the weekly movement direction of NIKKEI 225 index. To evaluate the forecasting ability of SVM, author compared its performance with Linear Discriminant Analysis, Quadratic Discriminant Analysis and Elman Backpropagation Neural Networks. The experiment results showed that SVM outperforms the other classification methods. Further, he proposed a combining model by integrating SVM with the other classification methods and found that outperforms among all other forecasting methods [17].

Bruce Vanstone et al. (2003) surveyed recent literature in the domain of applying Soft Computing to Investment and Financial Trading and analysed the literature according to the style of soft computing used, the investment discipline used, the successes demonstrated, and the applicability of the research to real world trading. Their paper contributed to expose the key areas where research was being undertaken and they attempt to quantify the degree of successes associated with the different research approaches [18].

Rohit Choudhry et al. (2008) proposed a hybrid machine learning system based on Genetic Algorithm (GA) and Support Vector

Machines (SVM) for stock market prediction. A variety of indicators from the technical analysis field of study were used as input features & the genetic algorithm was used to select the set of most informative input features from among all the technical indicators. The result showed that the hybrid GA-SVM system outperforms the stand alone SVM system [19].

Jin-Cherng Lin et al. (2007) presented a time series forecasting model by independent component analysis mechanism. They have extracted some underlying factors using time series and used those factors as a forecasting base. They have concluded that within component ambiguity, correlation approximation and mean difference problems, independent component analysis mechanism had intrinsic limitations for time series forecasting. Under the linear time complexity, the component ambiguity and mean difference problem was solved by the proposed evaluation. The empirical data showed that their model exactly revealed the exhibility and accuracy in time series forecasting domain [20].

V. DISCUSSION

As discussed in section II and III the stock prediction can be done by using fundamental and technical analysis. The fundamental analysis assumes that the investors are more logical and stock price (current and future) depends on its intrinsic value. As per fundamentalist, the market price of a stock tends to move towards its “real value” or “intrinsic value”. To find the intrinsic value of a particular stock the current and future overall health of the stock as well as the economy is required to be examined. The advantages of fundamental analysis are its systematic approach and its ability to predict changes before they show up on the charts. Fundamental analysis is a superior method for long-term stability and growth. But it is hard to time the market using fundamental analysis.

Technical analysis evaluates the stocks by analyzing statistics generated by market activity, past prices, and volume. It looks for peaks, bottoms, trends, patterns, and other factors affecting a stock's price movement. Future values of stock prices often depend on their past values and the past values of other correlated variables. Technical analysis looks for patterns and indicators on stock charts that will determine a stock's future performance. This analysis is largely preferred by the major stock traders and is good for shorter period also. Despite this fact technical analysis is criticized because it is highly subjective and different individuals can interpret charts in different manners. This analysis assumes that the market moves in trends dictated by the constantly changing attitudes of investors in response to different forces. Here it is assumed that the prices have tendency to go with the trend rather than against it and that the investors are 90% psychological, reacting to changes in the market environment in predictable ways.



Both these methods are having their own limitation and so are fail to give expected results. These tools are based on different analytical approaches and yield contradictory results. Moreover the results produced by these tools can be interpreted by the experts only and also these tools require a lot of time in a modern dynamic trading environment.

VI. CONCLUSIONS

In this paper, a review on various stock prediction techniques has been presented. On the basis of published and available literature, it can be safely concluded that the existing techniques are not suitable for prediction of stock market trends as well as price of different socks. There exist a gap between technologies and user requirement for a safe and accurate stock prediction system. If various political & economic factors which affect the stock market are also taken into consideration other than the technical indicators as input variables, better results may be obtained. Also, incorporating market specific domain knowledge into the system might help in achieving better performance.

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