Fundamental Analysis of Financial Parameters and Ranking using Artificial Neural Network

Anita H. Kenchannavar and Dr. S.F. Rodd

Abstract— Investing in stock market has been one of the most profitable options for people since long time as it yields high returns. But it is associated with a greater risk because stock price movements of a particular company depend on various factors such as market position, world economy, country’s economy, company’s growth, performance, etc. Hence, it requires a profound knowledge and a complete understanding of the company stocks, its performance, the global scenario, etc. for making safe investment decisions. In this context, many algorithms have been proposed and tools have been developed using which the stock market data has been analyzed and stock price movements have been predicted. In this paper an approach using Artificial Neural Network for classifying the companies based on the fundamental analysis of key financial ratios is presented. The result of this classification can then be used for ranking the companies for predicting the stock price in Indian market across different business sectors.

Keywords— Artificial Neural Network, Fundamental Analysis, Financial Parameter Ranking, Stock Price Movements.

I. INTRODUCTION

Stock market investment is both an interesting and challenging task for the investors. It is interesting because, one develops expertise to predict and derives joy when predictions come true. It is challenging because there are so many diverse parameters that decide the stock price and it also involves the risk of losing real money. Stock analysis is an active area of research and several authors have proposed techniques to analyze company stocks and predict their price in future to help users in making safe decisions about investing in the shares. Stock price prediction can be done using different approaches such as fundamental analysis and technical analysis. Every company listed under a stock exchange has various stock performance indicators such as Price-to-Earning (PE) ratio, Price-to-Book Ratio (PB), Price-to-Sales Ratio (PS), Earnings Per Share (EPS), Projected Earnings Growth (PEG), Return on Capital Employed (ROCE), Sales growth, Return-On-Equity (ROE), Debt-to-Equity Ratio, Dividend yield, Debt Status, etc. which will indicate the company’s worth in terms of its performance, expansion plans, growth, etc. These indicators can be evaluated by calculating related parameters. This information is very useful for the investor community for making smart investment decisions by predicting future performance of the company based on these financial parameters. An individual must gain knowledge before investing about the company and its performance such as its businesses, what is the current demand for its products and how the demand will be in next 3 to 5 years.

The paper is organized as follows: Section 2 discusses the related work carried out in this direction. In Section 3, standard data sources containing financial dataset about the companies required for analysis and prediction have been listed. Section 4 provides the methodology that will be used in the research work. Section 5 discusses the proposed work that will be accomplished. Finally Section 6 discusses the expected results followed by conclusion and references.

II. LITERATURE SURVEY

The following section gives an overview about the work carried out in this domain using different approaches addressing varied factors which affect the stock price movement. The review papers discuss the different approaches employed such as sentiment analysis, data mining, statistical analysis, etc. for carrying out the company stock price analysis and future prediction.

The authors Desheng Dash et. al. in their research work[1], propose an approach for analyzing the online stock forums which integrates the sentiment analysis and the machine learning algorithms based on the Support Vector Machine (SVM) and Generalized Auto Regressive Conditional Heteroskedasticity (GARCH) modeling. The result analysis depict that the investor sentiments have a powerful effect particularly on the value stocks compared to growth stocks. Jasmina Smalovic et. al. in their research [2] have performed sentiment analysis on discussions related to specific companies on Twitter sites and tried to correlate how they affect the company stock market price. To address this issue they have designed an active learning approach considering static Twitter data streams for training the Support Vector Machine sentiment classifier to find out the best Twitter specific preprocessing setting. The authors have used Granger’s causality test for static data analysis. The SVM classifier in this approach categorizes sentiments into 3 types – negative, positive and neutral. The results from the experiments show that probability of positive sentiments in tweet streams about a specific company can be used as an indicator for predicting the changes in stock closing prices. In
order to tackle the problem of growing financial markets and availability of huge amount of complex data, the authors in their research work [3], have introduced a novel method called CIMAWA- Concept for the Imitation of the Mental Ability of Word Association, which integrates word associations and lexical resources for carrying out sentiment analysis for financial markets in German language. The financial data was obtained from about 9,18,427 documents which included research articles, ratings from analyst, news, ticker news, recommendations, and comments since January 2000 to February 2014 and the analysis was done at different levels on a larger time scale basis. The research paper [4] presented by authors Vaanchitha Kalyanaraman, et. al. discusses about analyzing the sentiments from news articles to predict their effect on the stock prices. The authors have obtained the dataset by using the Bing API to get hold of the news articles about an individual company. They have created a specialized dictionary of sentiments for analyzing the news articles related to the stock market. The dataset has been tested by applying two different machine learning algorithms namely the Gradient Descent and Normal Equation for predicting the stock price movement. By comparing the accuracy of both the algorithms, the results show that Gradient Descent provided 81.82% accuracy on comparison with actual stock prices as compared to the Normal Equation. In the research article [5], an approach has been proposed by the authors Masoud Makrehchi and group, which labels the social media text as big losses or gains based on events providing meaningful automated labels which can be easily quantified on the basis of returns from individual stocks or indices. They have obtained important stock price movements and gathered appropriate contemporaneous, pre and post text from social media sources like twitter. For every tweet, they assigned a negative or a positive label and then by training the model on the data set they have predicted appropriate labels for future tweets. Finally the authors have considered the average of the net sentiments for each day and have shown that it has more predictive power to forecast the future price movement of the stock. The authors have come up with a successful trading strategy based on this system which resulted in significant returns as compared to other baseline methods. The trading strategy developed using this approach was able to beat S&P 500 by about 20% returns within the duration of 4 months. Using the automatically generated training data from the happenings in the stock market, the authors have built a model to study the patterns to find hidden parameters affecting the stock prices. An effort [6] has been made by the authors to help the investors deal with rising amount of information to make profitable investment resolutions. The authors have combined text mining and sentiments of the investors in a novel two-stage approach to predict the impact of the specific news about a company on its future stock price. They have stated that this particular combination of data mining and investor sentiments improves the forecasting results and also results in a higher accuracy using the financial related word lists for sentiment analysis as compared to generic dictionary. The results obtained using the current approach indicate that better improvement in the prediction of the stock price can be attained with the articles expressing positive sentiments (“boom”) as compared to articles expressing negative sentiments (“ruin”).

In the research paper [7], the authors have recommended a model for predicting the companies’ future stock price by extracting the characteristic features from the time series data and social networking sites and assess its performance. Experimental results indicate that the proposed approach outperforms the other baseline methods in terms of magnitude prediction measures such as MAPE, RMSE and MAE considered for three popular Japan companies’ stocks in US market. From behavioral economics it is seen that emotions play a major role in an individual’s behavior and decision making. In this context, Johan Bollen, et. al. [8], have tried to analyze as to how the public emotions or public mood can be an indicator for predicting the economical changes of a company. The authors have analyzed the textual content of daily Twitter feeds and have tried to correlate the public mood with the value of Dow Jones Industrial Average over a period of time. The analysis of the Twitter feeds and the prediction of the company’s economic status were done using two available mood tracking tools – Opinion Finder and Google Profile of Mood States (GPOMS). The Opinion Finder analyzed the public sentiments by measuring positive vs negative while the GPOMS analyzed the Twitter feeds based on the 6 states of human mood - Calm, Alert, Sure, Vital, Kind, and Happy. The resulting mood time series from the tools was cross verified by comparing their ability to detect the people’s response to Thanksgiving Day and Presidential elections in 2008. A Self-Organizing Fuzzy Neural Network and a Granger Causality test were then used to inspect the hypothesis that the public mood analysis as carried out by Opinion Finder and GPOMS time series can predict the changes in DJIA stock price closing values. From the experimental results it was found that by including specific mood dimensions the prediction accuracy of daily DJIA stock price movements could be improved to 86.7% and also the Mean-Average Percentage Error was reduced by more than 6%. Jasmina Smailović, et. al. [9] has tried to explore whether the public opinion data about the companies and their products available on Twitter feeds are a suitable source for predicting the closing stock price movements. The authors have used Granger causality test to show that polarity of sentiments (positive or negative) can be used for providing indications about the stock prices a few days in advance. Later the authors have adopted Support Vector Machine approach to classify the Twitter feeds into positive, negative and neutral which resulted in improved prediction of the stock price movements. The authors Yoonsin Kim, et. al. have introduced a method of mining text [10] opinions to analyze Korean language news to predict rises and falls on the KOSPI (Korea Composite Price Index) by performing NLP on the textual content. The experiments show that this method can be used to understand the unstructured big-data and also reveal that news sentiment can be used for prediction of stock price fluctuations.

Financial applications such as trading systems use common approaches like heuristic methods or evolutionary algorithms [11]. The authors Yao-Hsin Chou et. al. have presented a method which will help the traders to determine the best time
to sell or buy stocks to maximize the profit with low risks by applying a trading system using the quantum inspired Tabu search algorithm to find the optimal composition and combination of strategies. Experimental results using this approach show much better performance in terms of earning money than other approaches and outperforms the buy and hold method. In the article [12], a new method for fuzzy forecasting based on two-factors second-order fuzzy-trend logical relationship groups and the probabilities of trends of fuzzy-trend logical relationships has been discussed. This method has been used to predict the TAIEX and NTD/USD exchange rates. The experimental results clearly indicate that the presented method outperforms the existing methods.

The authors in their research work [13], propose a technique to predict the Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX) using fuzzy time series and automatically generated weights of multiple factors. This method generates the predicted value of the next trading day depending on the closing index and the final forecasted variation of TAIEX on the trading day. The results after experimentation show that the proposed method performs better than the other existing methods. A new complex neurofuzzy AutoRegressive Integrated Moving Average (ARIMA) computing approach is presented in [14] for the problem of time-series forecasting the future stock price. This method integrates a Complex Neuro Fuzzy System (CNFS) using Complex Fuzzy Sets (CFSs) and ARIMA models to form the proposed computing model, CNFS-ARIMA. A basic structure [15] for integrating the news automatically in stock trading strategies has been presented in 2014 for predicting stock market prices. According to [16], the stock market traders deal with statistics, company analysis, news etc. that influence economy in real time. The purpose of this paper is to review the studies about the impact of stress on the decision making process and on biological stress parameters applied in the sensor design and also to compare different ways to measure stress using sensors and to suggest new directions in the use of sensor technology in stock markets. A systematic approach has been developed to estimate the Indian stock market price and their performance analysis [17] which uses prediction algorithms and functions. The authors have made use of Weka 3.63 tool to obtain more accurate stock prediction price and compare them with functions such as isotonic regression, Gaussian processes, LMS, linear regression, multilayer perception, pace regression and SMO regression. It is observed from the results that isotonic regression function offers the ability to predict the stock prices accurately than other techniques.

The stock market prediction without sentiment analysis has been done in [18] based on the web traffic extracted from financial online communities. The authors have collected financial dataset of SP500 stocks for about 8 years and the classifier has been trained using the features extracted from the web traffic for prediction purposes. The paper [19] describes a multi-agent system that works on numerical, financial and economical data in order to evaluate the company’s position in the market, profitability, performance, future expectations during the company’s evolution. The authors have developed a prototype for result validation. A general stock price prediction framework [20] has been developed to enable the use of different external signals to predict the stock prices based on the news summary. The authors have experimented on five-year Hong Kong Stock Exchange data with news report by FINET. Evaluations have been done at individual stock level, sector index level and market index level. Results indicate that news summarization based stock price prediction effectively outperforms the prediction based on full-length article on both validation and independent testing sets. The Kappa measure is used to quantify [21] the accuracy of stock market prediction by various media houses and the stock with highest Kappa measure is considered to be the best stock to buy. The Kappa measure also predicts the risk involved in the purchase/sale of each shares.

According to [22], the authors have evaluated the foreign exchange risk exposure and its determinants of listed companies on the Shangai and Shenzhen Stock Exchange based on the data available over the period July 2005 to July 2011. The findings are that: 1) Listed Companies in China have significant exposure to foreign exchange risk and firms can be damaged. 2) Based on average level, U.S. dollar exchange rate fluctuations influence the industry. 3) The companies exchange risk are affected greatly by firm’s dividend payout ratio (DIV), market value of equity (SIZE), long term debt ratio and quick ratio. In paper [23], a sparse, smooth, regularized, regression model has been proposed to infer volatility of data while explicitly accounting for dependencies between different companies. The authors show how their model captures the fluctuations in volatility over different economic conditions such as financial crisis periods. Further, the authors also show how the proposed model assists in discovering useful correlations with external factors such as oil price; inflation etc. based on the regression estimates. Corporation financial distress has been analyzed in [24] and the authors use a traditional BP neural network model and propose PNN model to predicate the financial distress. The results demonstrate that PNN model has higher explanatory power in predicating financial distress than BPN model.

### III. STANDARD DATA SOURCES

Many websites provide listing of financial data and indicators needed to analyze and predict the movement of company’s stock price value. This will help the investors to make wise investments in stock market. Table 1 lists the links where financial dataset of companies are available for use in the research.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><a href="http://www.screener.in">www.screener.in</a></td>
</tr>
<tr>
<td>2.</td>
<td><a href="http://www.moneycontrol.com">www.moneycontrol.com</a></td>
</tr>
<tr>
<td>3.</td>
<td><a href="http://www.bseindia.com">www.bseindia.com</a></td>
</tr>
<tr>
<td>4.</td>
<td><a href="http://www.nseindia.com">www.nseindia.com</a></td>
</tr>
<tr>
<td>5.</td>
<td><a href="http://www.hdfcsec.com">www.hdfcsec.com</a></td>
</tr>
</tbody>
</table>
IV. RESEARCH METHODOLOGY

The prediction of the stock price of a company so far has been concentrated on the parameters such as opening and closing stock price for the day, high and low values of the index. The techniques employed in the prediction research are sentiment analysis, data mining, statistical analysis, time series analysis, different machine learning algorithms such as SVM, Back Propagation algorithm, Artificial Neural Network, etc. Very few researchers have taken into consideration the company’s financial ratios for predicting and analyzing the stock price of a company. The parameters considered for the prediction [29] are PE ratio, EPS ratio, Net Asset Value (NAV), Net Profit, etc. for stock ranking using fundamental analysis. In this paper, a novel approach of predicting stock prices based on fundamental parameters of a business enterprise has been proposed. Here the main focus is on analyzing the company performance using other important financial ratios such as Return on Capital Employed (ROCE), Sales growth, Dividend Yield, and Debt to Equity ratio for the stock price prediction using the Artificial Neural Network.

V. PROPOSED RESEARCH WORK

In this work, the Radial Basis Function (RBF) is used to analyze and classify the Indian companies based on their key financial ratios to assist people in making investments. Radial Basis Function is an Artificial Neural Network approach which makes use of radial basis function as activation functions. Radial Basis Function Networks can be used for different purposes including time-series prediction, classification, system control and function approximation. Here the main intention of using RBF is to classify the companies as good (1) or bad (0) by taking into consideration few key financial indicators of a company such as ROCE, Debt-to-Equity ratio, Sales Growth and Dividend Yield to help people for investments.

A. Network Architecture

Radial basis function (RBF) networks typically have three layers: an input layer, a hidden layer with a non-linear RBF activation function and a linear output layer. As shown in Figure 1, an input vector $x$ is used as input to all the radial basis functions, each with different parameters. The output of the network is a linear combination of outputs from the radial basis functions.

Here for classifying the companies using the RBF, the input data will be the key financial ratios like ROCE, Debt-to-Equity ratio, Sales Growth and Dividend Yield. The output will be either 0 or 1 i.e. the companies will be classified as either good (1) or bad (0) based on their performance using the Gaussian curve shown in Figure 2. If the computed value lies within the curve the output of the RBF will be 1 i.e. the company will be classified as “good”. If the value lies outside the curve then the output will be 0 indicating that the company is not performing well and hence “bad” for investment.

Figure 2: Classification in RBF using Gaussian Curve

Table 2 shows the training data to be given to the RBF function.

<table>
<thead>
<tr>
<th>Company</th>
<th>BSE Symbol</th>
<th>D/E (%)</th>
<th>ROCE (%)</th>
<th>Sales growth (%)</th>
<th>Dividend Yield (%)</th>
<th>classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maruti</td>
<td>0.02</td>
<td>24.92</td>
<td>9.54</td>
<td>0.62</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>LUPIN</td>
<td>0.28</td>
<td>24.63</td>
<td>19.55</td>
<td>0.51</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>M&amp;M</td>
<td>0.87</td>
<td>10.24</td>
<td>16.18</td>
<td>0.90</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Bajaj-Auto</td>
<td>0.01</td>
<td>43</td>
<td>6.70</td>
<td>1.97</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Infi</td>
<td>0.00</td>
<td>34.93</td>
<td>17.82</td>
<td>2.33</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mindtree</td>
<td>0.00</td>
<td>33.85</td>
<td>23.62</td>
<td>2.20</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>BajajTempo</td>
<td>0.00</td>
<td>17.73</td>
<td>14.35</td>
<td>0.23</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TataMotors</td>
<td>0.79</td>
<td>12.65</td>
<td>17.67</td>
<td>0.04</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>AuroPharma</td>
<td>0.18</td>
<td>27.83</td>
<td>25.97</td>
<td>0.30</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AjantPharm</td>
<td>0.02</td>
<td>50.47</td>
<td>27.63</td>
<td>0.41</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8K Miles</td>
<td>0.00</td>
<td>42.25</td>
<td>75.53</td>
<td>0.00</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>KPTT</td>
<td>0.09</td>
<td>21.52</td>
<td>19.05</td>
<td>1.58</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wipro</td>
<td>0.04</td>
<td>23.36</td>
<td>10.55</td>
<td>1.23</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>ShreeCem</td>
<td>0.08</td>
<td>9.39</td>
<td>10.02</td>
<td>0.14</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>JKLakshmi</td>
<td>1.20</td>
<td>3.33</td>
<td>14.66</td>
<td>0.05</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Using the training data shown in Table 2, the RBF algorithm can be used to classify any given company as good or bad. Based on the classification result the companies can be ranked on the basis of their performance.

VI. EXPECTED RESULTS

The objective here is to improve the prediction accuracy for classifying the companies. This can be done by altering the different parameters in the algorithm like learning rate, number of neurons (N) in the hidden layer, or the type of RBF. This result can also be used to rank the companies depending on key ratios. Further this classification result can be used to
compare with the results from the SVM classifier algorithm where the classification is done according to Figure 3.

![Figure 3: Classification in SVM Classifier Algorithm](image)

### VII. CONCLUSION AND FUTURE SCOPE

Research in the stock analysis so far has been concentrated on stock prediction using the parameters like opening and closing stock price for the day, high and low values of the index. The techniques employed in the prediction research are sentiment analysis, data mining, statistical analysis, time series analysis, different machine learning algorithms such as SVM, Back Propagation algorithm, Artificial Neural Network, etc. Not much research on the stock prediction has been carried out using the Fundamental Analysis. An Artificial Neural Network has been proposed for carrying out the fundamental analysis for predicting the performance of the company using the Radial Basis Function. In the first phase the based on the key ratios the companies would be classified according to their performance as good or bad. Based on this classification the companies will be ranked according to financial performance indicators. In the second phase this result will be used to compare with the results from the SVM classifier algorithm. As a future improvement, an ensemble approach combining the results of a numbers of Machine Learning Techniques (at least 3) to improve the prediction accuracy will be experimented.

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### REFERENCES


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