Forecasting Market Price of Stock using Artificial Neural Network

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ABSTRACT

Stock determines the share of the ownership of a company. It represents the assets and earnings and overall contribution of the company in any country's economy. The stock of a company is partitioned into shares.

Decision making in a stock market is not easy as it involves price trends, market nature, company's stability, different rumors, brand image, venture capitalist funds etc. It becomes very imperative to necessarily extract information that is vital for the people to understand and analyze the risk factors necessarily involved to forecast the stock market from the investor's viewpoint. Thus methods like technical analysis, time series analysis and statistical analysis are an attempt to predict the price but unfortunately none of these methods are a consistently acceptable tool. Hence artificial neural network i.e. a field of Artificial Intelligence is a desired way to discover unknown and hidden patterns of the data.

There are two different phases i.e. training and other is predicting. Here Back propagation algorithm is used to training session and Multilayer feed forward network is a network model for predicting price accordingly. This prediction would be done on various parameters that would be considered as input to the multilayer perceptron model. These parameters are depends on data i.e. gained by the company.

General Terms

Artificial Neural Network, Stock Price, Fundamental Analysis, Technical Analysis, Forecasting.

Keywords

Artificial Neural Network (ANN), Price-Earnings Ratio (P/E Ratio), Simple Moving Average (SMA), Price Rate of Change (PROC)

1. INTRODUCTION

Stock is a share in the ownership of a company, Stock represent a hold on the company's assets and earnings. Whether you say share, equity or stock it's all means the same things. More the stock u acquires, greater will be your ownership stake in the company. The stock of a corporation is partitioned into shares Shares represent a fraction of ownership in a business. Ownership of shares may be documented by issuing of a stock certificate. This certificate is a lawful document that contains all information of the shareholder i.e. amount of share owned by him and other details of the shares.

Share market or equity market is a place where equity of publicly held companies is traded through exchange or over-the-counter markets. Stock gives part of ownership to the investors in a company in trade of capital to the firm, hence it is one of the important part of the free market economy. Stock market helps small scale industry to obtain their capital from stock investors to make growth of their company.

Wikipedia defines it as a stock market or equity market is the aggregation of buyers and sellers. It is a loose network of economic transactions, not a physical facility or discrete entity of stocks or shares. These are securities listed on a stock exchange as well as those only traded privately.

Investors who involve their currency in stock, automatically becomes a part of the in the company financial achievements. When the company is in profitable margin investors can sell their stock at profit to obtain their money or anyways they make their money through dividends. On the other side if the company is at loss margin then the investors may lose their money as the price of the stock will decrease and the investors have to sell their stock at fewer prices. Hence Stock market is promising financial investment and that can generate great wealth but it is a very high risk investment thus lots of researchers have used multiple methods in computer science and economics to gain vital information and to make great fortune out of stock market investments [1].

Investing on stock market needs careful planning with deep analysis which now a days is possible using advanced technologies with large computational power, neural network, relational database etc.

This paper demonstrate stock value prediction using Artificial Neural Networks (ANN) it uses multi layered perceptron model. The remaining part of the paper is structured as follows: Section 2, states prediction analysis methods. Section 3, explains the architectural model of the system. Section 4, lists the features which were considered for analysis purpose. Section 5, explains the algorithm section . Section 6, explains the results. Section 7, provides a concluding remark.

2. PREDICTION ANALYSIS METHODS

Major prediction analysis methods are fundamental analysis, technical analysis and machine learning method.

2.1 Fundamental Analysis

Fundamental analysis considers economic factors as fundamentals. Fundamental analysis is the physical study of a company with respect to products sales, workers, infrastructure, and quality [2]. This analysis is mostly suitable for long terms prediction as it depends on statistical data of the company [3].

2.2 Technical Analysis

Technical analysis mainly considers indicators on stock charts that will decide the future movement [10]. It normally uses technical data like price, volume, highest and lowest prices to

forecast price moments. This kind of analysis is normally suitable for short time span [2].

2.3 Machine Learning

Machine learning method uses artificial Intelligence (AI), for training the system and then use that trained system for forecasting future movements in stock.

3. SYSTEM ARCHITECTURE

System architecture consists of various blocks which are explained in detail below and has been shown in figure 1.
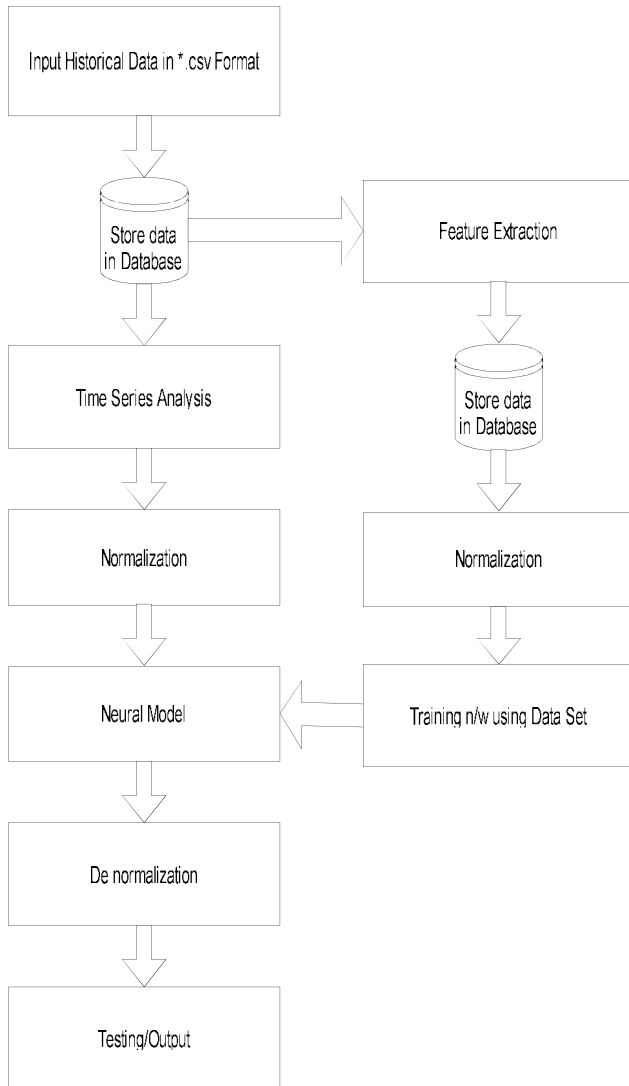

Figure 1: System Architecture

3.1 Acquiring Data

The first step is to acquire historical stock data. There are various sites available, which provide historical data such as yahoo finance [5], money control [6]. However, here for experimental purpose data is been used from Yahoo finance site from where prior stock values are been available for download in csv.* format file. Data available over there are obtained in daily, monthly, weekly intervals.

3.2 Feature Extraction

Feature selection play vital role in stock prediction. Various features are need to be extracted for prediction accuracy. The list of the features have been explained in section 4.

3.3 Normalization

The feature obtained from the previous stage are been normalized. Data normalization means adjusting values measured on various different scales to common scale. The normalization formula used is given in equation (1).

$$X' = \frac{(X - minA)}{maxA - minA}(new_{maxA} - new_{minA}) + new_{minA} \qquad (1)$$

Where

X = Actual input

X' = normalized output

minA= minimum value of data

maxA=maximum value of data

New minA , New maxA =Boundary values of the new data range.

3.4 Time Series Analysis

Here the analysis of each parameter of previous few days is done which is pass to neural model in normalized form.

3.5 Multi-layered perceptron model

Here the multi perceptron model is used for predicting the stock value to the closest range. In the training phase, sufficient amount of stock data would be given to get better results. The figure given below explains the role of multi layered perceptron model.
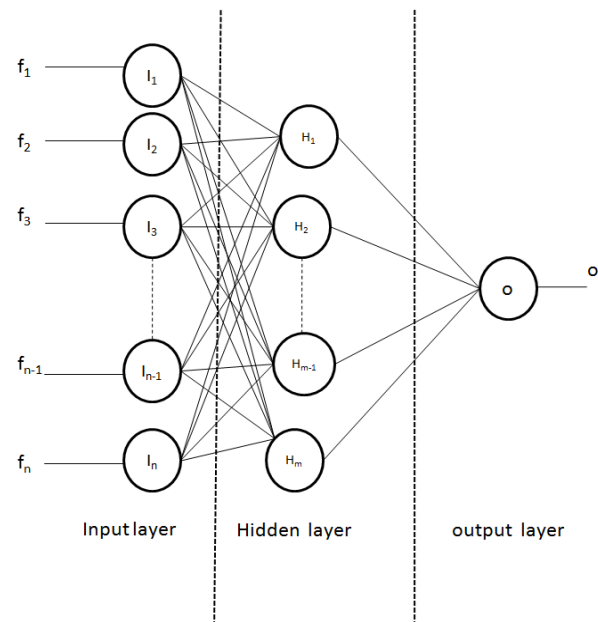

Figure 2: Multi Perceptron Model

In the above figure 2 $f_1, f_2, ..., f_{n-1}, f_n$ are the feature which will be given as input to the neuron $I_1, I_2, ..., I_{n-1}, I_n$ of input layer of multi layered perceptron model. The neuron $H_1, H_2, ..., H_{m-1}, H_m$ are the neurons of the hidden layer of Multi layered perceptron model. O is output neuron of output layer.

Initially weight assign to every edge is near to zero. During the training process, the weight will be updated [7] [8]. The activation function is used has tan h for better result [9].

3.6 De normalization

De normalization is used to for predicting the close value of the stock from the neural output using equation (2).

$$D = output * (maxA - minA) + minA \qquad (2)$$

where

D = Denormalized output

output = Neural network output

maxA = max value of close column

minA = min value of close column

3.7 Stock Prediction

This is the last phase of the proposed framework where the stock value is predicted. Depending on the stock predicted it will prompt the user regarding the rise or fall in stock which will ultimately help the user to take appropriate decision.

4. FEATURE EXTRACTION

List of the features which has been extracted has been given below. Some feature are directly obtained from csv file and other are derived from it.

4.1 Open Price

It is the price of that stock at the open of the trading day

4.2 Share Volume

In a particular day total number of share sold is called share volume.

4.3 Index Ratio

Index ratio is been computed as given in equation (3).

$$\text{Index Ratio} = \frac{Today's Volume}{Previous\ day\ Volume} \text{ X Previous day index ratio} \qquad (3)$$

4.4 P/E Ratio

It is known as Price-Earnings Ratio. It is the connection between the share price and company's earnings. It is calculated by dividing the company's current market price / share with the earning per share of previous quarter i.e trailing EPS or estimated EPS of the next 4 quarters. It is been computed as shown in equation (4).

$$\text{P/E Ratio} = \frac{Share\ Price}{Earnings\ Per\ Share} \qquad (4)$$

4.5 Simple Moving Average (SMA)

Simple Moving Average (SMA) is primordial widely used technical indicator that display average value of stock price. A classical short term moving average ranges from 5 to 25 days , long term from 100 to 250 days and intermediate from 5 to 100 days. It is been computed as given in equation (5).

$$\text{Simple Moving Average (SMA)} = \frac{1}{N}\sum_{i=0}^{N} xi \qquad (5)$$

where xi = stock open value & N= 1,2,3.....N

4.6 On Balance Volume

On Balance Volume calculates buying and selling demands as accumulative indicator. OBV uses volume of stock trades i.e both buying and selling to predict where the share price is heading. As shown in equation (6) and equation (7).

If Today's Close > Yesterday's Close

OBV= Yesterday's OBV + Today's Volume \qquad (6)

IF Today's Close < Yesterday's Close

OBV = Yesterday's OBV - Today's Volume \qquad (7)

4.7 Price Rate of Change(PROC)

Price Rate of Change (PROC) is a technical indicator that calculates percentage change of today's price value as compared to price value of certain number of days ago. It is been calculated using equation (8).

$$\text{Price Rate of Change} = \frac{(Today's\ Close - Close\ X\ period\ ago)}{Close\ X\ period\ ago} X\ 100 \qquad (8)$$

5. ALGORITHM

The algorithm used for implementation and analysis of the framework is given below:

Step 1: Acquiring the historical data

Collect the historical data in *.csv format and other values which will be need as input parameters

Step 2: Selection of Features

Feature which has been selected are mention above.

Step 3: Normalization

Normalization of the features is done using information given in section 3.3

Step 4: Artificial Neural Network (Multilayer Perceptron Model)

Pseudo code for Multilayer Perceptron Model is given below:

Input: N= Starting of neural network model. X={x_1....x_h} // Input tuple from training set. O= {O1} // Output tuple desired.

Training: X is input layer. Initially weights small random values for edges Generate random weight values for edges connecting each input node i to hidden layer node j with weight $w_{i,j}$. Weighted sum of the input to the jth node of the hidden layers is given by equation (9).

$$Net_j = \sum w_{ij}x_j \qquad (9)$$

Based on the hidden layer generated, the actual output layer value which is calculated using activation function equation (10) [7] [8] [9].

$$x_k = \tanh(Net_j) \qquad (10)$$

The difference between the actual output output x_k and the expected output O_k for which training is been done is given by equation (11).

$$\Delta_k = x_k - O_k \qquad (11)$$

The error signal for node k^{th} in the output layer is calculated as equation (12).

$$\delta_k = \Delta_k * O_k(1 - O_k) \qquad (12)$$

Modify the weight, $w_{j,k}$, between the output node, k, and the node j using learning rate, l_r (approx.=0.7) is given by equation (13) and equation (14).

$$w_{j,k} = w_{j,k} + \Delta w_{j,k} \qquad (13)$$

$$\Delta w_{j,k} = I_r * \delta_k * x_k \qquad (14)$$

Repeat the training step expect initialization till $\delta_k < 0.05$(approx) for every user.

Step 5: De normalization

Neural network output is de normalized using formula given in section 3.6. This de normalization is necessary for predicting stock closing price from neual network ouptut.

Step 6: Stock Prediciton

For stock prediciton previous two days data is inputted to neural network then this pattern is match with the testing file tp produce an output which is then de normalized to get predicted close price.

6. RESULT

Using this concept a system was developed to predict future stock values using neural network. The historical data of few companies as well as other parameters that were needed for computational purpose were gathered. Figure 3 shows the parameters which were obtained from historical data and other parameters which were derived from basic parameter. Below figure 4 shows the graphical representation of the actual values and predicted values of infosys. Historical data of this company was collected from yahoo finance site and were given as inputs to the system. Designed system was trained using this data ranging from 01-01-2015 to 02-03-2015 and the closing values were predicted from 09-03-2015 to 13-03-2015 as shown in figure 3. Table 1 shows Actual Price, Predicted Price and Error Rate with respect to actual price of Infosys.

| | | | | | | | | View Prediction values | View Stock values | View Graph | logout [amod] |

INFY.NS ▼

Date	Open Value	Close Value	Volume	Index Ratio	P/E Ratio	SMA	On Balance Volume	PROC - 5 days gap
2015-01-01	1969	1974	500600	1000.000000	67.617483	1969.000000	500600.000000	1974.000000
2015-01-02	1972	2013	1694500	3384.938074	68.946266	1970.500000	2195100.000000	2013.000000
2015-01-05	2010	1996	2484200	4962.445066	68.353792	1983.666667	-289100.000000	1996.000000
2015-01-06	1980	1954	2416800	4827.806632	66.925680	1982.750000	-2705900.000000	1954.000000
2015-01-07	1965	1964	1812400	3620.455453	67.245919	1979.200000	-893500.000000	1964.000000
2015-01-08	1986	1973	3391200	6774.270875	67.584950	1980.333333	2497700.000000	-1.987084
2015-01-09	1980	2074	11215800	22404.714343	71.043892	1980.285714	13713500.000000	3.907816
2015-01-12	2092	2116	3189700	6371.753895	72.465151	1994.250000	16903200.000000	8.290686
2015-01-13	2108	2089	2200300	4395.325609	71.538768	2006.888889	14702900.000000	6.364562
2015-01-14	2099	2129	2480300	4954.654415	72.900119	2016.100000	17183200.000000	7.906741

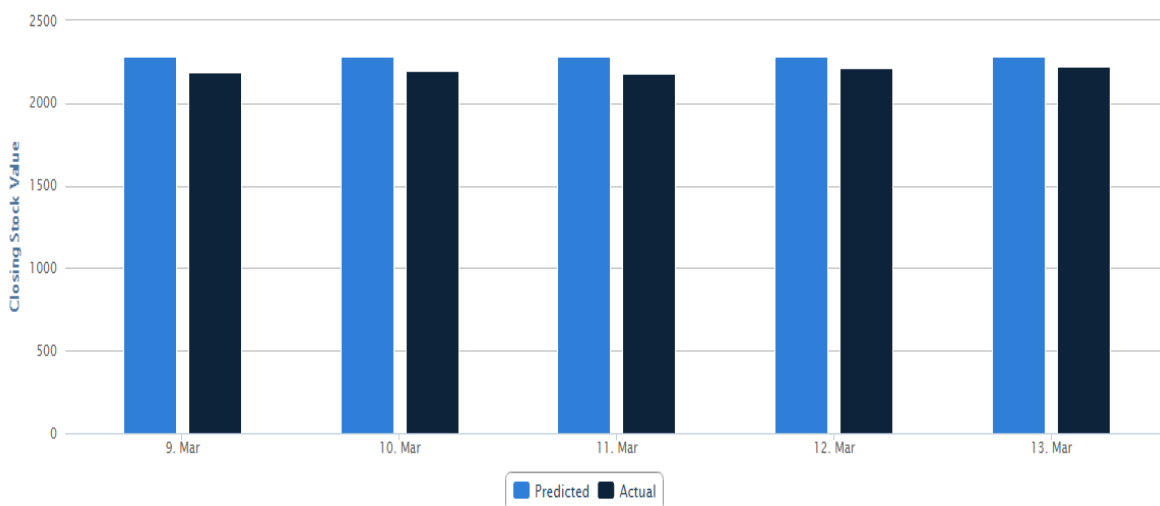**Figure 3: Basic and derived parameter of Infosys**

Figure 4: Graphical representation of predicted value vs. actual value of Infosys

Table 1: Actual Price, Predicted Price and Error rate of Infosys

Date	Actual Price	Predicted Price	Error Rate
09-03-0215	2190	2281	0.04155251
10-03-0215	2198	2285	0.039581437
11-03-0215	2182	2286	0.02882883
12-03-0215	2218	2288	0.047662694
13-03-0215	2220	2284	0.031559963

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7. CONCLUSION AND FUTURE WORK

This paper provides system for forecasting stock price value using Artificial Neural Network that will be beneficial for shareholders. Our main goal is get maximum profit from the stock by using such a system for prediction. Investors make great efforts to out-perform the market. Stock prediction will always be an area of research. This system will be more accurate and error rate will reduce if we use more amounts of data for training process. Further research on this topic can be done by acquiring relevant information from financial news data and using this information for prediction purpose.

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