Stock Price Analysis and Forecasting using Recurrent Neural Network based LSTM Technique

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Abstract: - The stock market is an emerging network that offers an infrastructure for all financial transactions from the world in a dynamic rate called stock value, which is devised using market stability. Prediction of stock values provides huge profit opportunities which are considered as an inspiration for research in stock market prediction. Long short term memory (LSTM) is a model that increases the memory of recurrent neural networks. Recurrent neural networks hold short term memory in that they allow earlier determining information to be employed in the current neural networks. For immediate tasks, the earlier data is used. We may not possess a list of all of the earlier information for the neural node. The long short-term memory (LSTM) and gated recurrent unit (GRU) models are popular deep-learning architectures for stock market forecasting. Various studies have speculated that incorporating financial news sentiment in forecasting could produce a better performance than using stock features alone. This study carried a normalized comparison on the performances of LSTM and GRU for stock market forecasting under the same conditions and objectively assessed the significance of incorporating the financial news sentiments in stock market forecasting. Both the LSTM-News and GRU-News models are able to produce better forecasting in stock price equally.

Keywords: - Stock Market, LSTM, GRU

I. INTRODUCTION

The economic strength and the ability of a nation to gain the most from its accumulated human and natural resources require well developed Financial markets and institutions. Financial Markets and institutions evolve in response to the desires, technologies and regulatory constraints of the investors in the economy.1 Stock markets being a part of financial markets provide and allocate long term capital to the corporate sector and ensure liquidity for such assets. Savings of the people can easily be transformed into long term capital through stock markets only in an environment where a strong investor friendly stock market prevails. Behaviour of prices of industrial securities in the secondary market plays a critical role in pulling the peoples savings to satisfy the long term financial needs of corporate sector. After the opening up of Indian economy in 1991, financial markets in India, particularly the stock market has become highly sensitive to the developments in the international market and the global economy. The recent turmoil in the global markets subsequent to the war on terrorism and the tech stock melt down had affected the market too adversely. The boom and bust in the information technology shares in India in the last few years has been highly correlated with movements of the technology shares in the NASDAQ market. In view of the strong linkage between the Indian and the international stock markets, the domestic stock market has become more vulnerable to the shocks of international financial markets.

Indian stock market has shown extreme volatility in the last decade, with prices surging wildly, without any change in fundamentals. The BSE Sensex, which was more than 5000 points in the year 2000, has dipped to less than 3500 points by the second half of the year 2001. In addition to stock market scams at regular intervals, the fall of information technology shares, which has reached to the highest levels, has brought down the Sensex drastically in the financial year 2000-01. Later in 2008 also SENSEX started at 20,352 in January and drastically fell to 9162 in December. The security market exhibits various patterns and styles which are either seasonal at times and shall not follow any seasonality some more times. There are various factors which influence stock market behavior as it does. Be it the political stability/instability; government and RBI policies like interest rates, repo rates, tax structure, International markets performance, developed nations financial structure etc. Spread of rumors regarding political and economic events is at peak at the time of general elections, announcement of budget and when companies are about to give their financial report. Basing on such information FlI's take decision and trigger a bull or a bear trend. Many times even the fundamentals of a company do not have any meaning. The market rule of "Buy low, sell high"2 comes into force.

II. STOCK MARKET PREDICTION

Stock market prediction is a significant task for the financial decision-making process and investment. Even though stock price prediction is a key problem in the financial world, it contributes to the growth of efficient methods for stock exchange transactions. Generally, stock markets are in the form of non-stationary, non-linear and uncertain even so financial experts recognized it is complex to produce precise predictions. Stock market prediction is a challenging job due to its high dynamic and unstable. Stock market prediction plans to compute the future value of a company stock trade on exchange as well as consistent prediction of future stock prices obtains high profits to investors. Various researches applied numerical data and news for the

prediction of the stock market. Commonly, based on the number of information sources, the stock market prediction technique is experimented on selecting the numerical data by analysing the news data [12].

In basic, forecasting behaviours are separated into three levels, such as short, medium and long. Furthermore, stock market movements are influenced by various macroeconomical aspects, like bank exchange rate, commodity price index, investors' expectations, bank rate, general economic conditions, investor's psychology, firms' policies, institutional investors' choices, political events and so on [8, 9]. Additionally, stock value indices are computed using higher market capitalization stocks, whereas several technical parameters are also employed to obtain statistical information about stock price values [13]. In the stock market, there are two assumptions for predicting stock price value. The first one is EMH stating at any time, stock price completely confines all identified information about stock where all identified information's are utilized through market participants and also random price variations obtains new random information's.

Therefore, stock prices execute a random walk, that is every future price does not follow any patterns or trends. This assumption deduces fluctuations, so incomplete or delayed information controls the stock market prices. In addition, an exterior incident influences successive stock market prices, although the precise prediction of a stock price is complex. From the prediction perception, it can be categorized into two types, namely stock price trend and stock price forecast. The stock price trend is also named as classification, and stock price forecast is also termed as regression [14]. Basically, the time duration for stock price trend prediction is highly related with previously selected features [7].

The prediction of stock market future price is very significant for investors, because of the identification of suitable movement of stock price decreases the risk of future trend calculation. The industry, economy and other correlated features are considered to compute the intrinsic value of a company, which helps to forecast stock prices from fundamental analysis method. Stock market decision-making technique is a very complex and significant job because of unstable and complex nature of the stock market. It is necessary to discover a huge quantity of valuable information created through the stock market. In addition, every investor has an imminent requirement for identifying future behaviours of stock prices.

Although, it helps the investors to achieve the best profit by identifying the best moment to sell or buy stocks. Normally, trading in stock market can be performed electronically or physically. The investor becomes the owner or partnership of a particular company, while an investor obtains a particular company share. Furthermore, financial data of the stock market is very complex in nature, so for predicting stock market behaviour is also complex. The stock market prediction helps the investors to take investment decisions by offering strong insights regarding stock market behaviour for reducing investment risks.

III. PROPOSED METHODOLOGY

The market volatility study is more important for policy implications and financial market participants for their future earnings. The Up and Down in the market will add a wedge for the market. The SEBI can improve their reforms of National Stock Exchange to educate the investor in terms of risk involved, return and fluctuation in the market.

In this thesis new solutions that overcome aforementioned challenges in share market prediction strategy adopt the long short term memory (LSTM) technique.

Long Short-Term Memory (LSTM) is one of many types of Recurrent Neural Network RNN, it's also capable of catching data from past stages and use it for future predictions.

In general, an Artificial Neural Network (ANN) consists of three layers:1) input layer, 2) Hidden layers, 3) output layer.

In a NN that only contains one hidden layer the number of nodes in the input layer always depend on the dimension of the data, the nodes of the input layer connect to the hidden layer via links called 'synapses'.

The relation between every two nodes from (input to the hidden layer), has a coefficient called weight, which is the decision maker for signals.

The process of learning is naturally a continues adjustment of weights, after completing the process of learning, the Artificial NN will have optimal weights for each synapses.

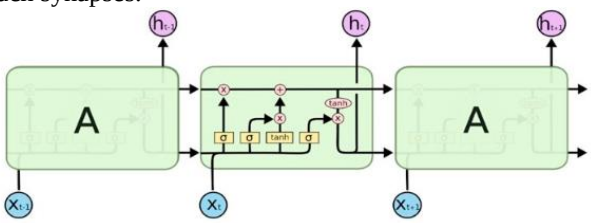

Fig. 1: The internal structure of an LSTM

The principal component of LSTM is the cell state. To add or remove information from the cell state, the gates are used to protect it, using sigmoid function (one means allows the modification, while a value of zero means denies the modification.). We can identify three different gates:

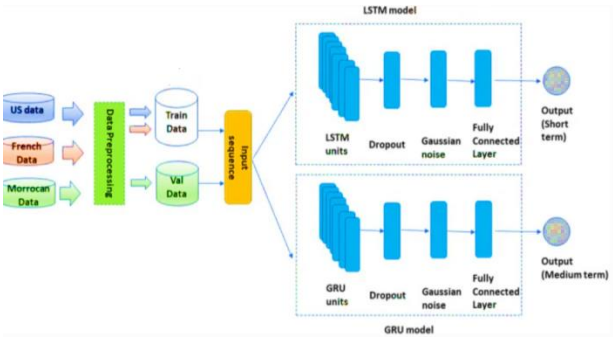

Fig. 2: Flow Chart of Proposed Methodology

Forget gate layer: Looks at the input data, and the data received from the previously hidden layer, then decides which information LSTM is going to delete from the cell state, using a sigmoid function (One means keeps it, 0 means delete it). It is calculated as:

$$f_t = \sigma(w_f[h_{t-1}, x_t] + b_f) \quad (1)$$

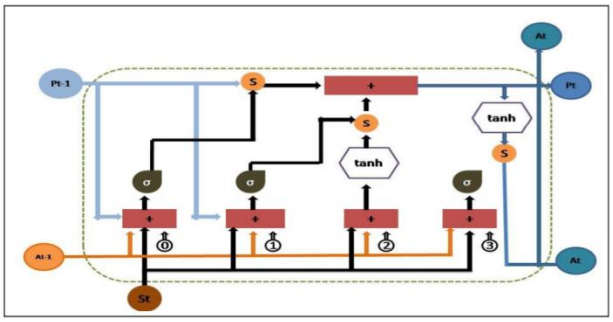

Fig. 3: Working of LSTM

Input/Update gate layer: Decides which information LSTM is going to store in the cell state. At first, input gate layer decides which information will be updated using a sigmoid function, then a Tanh layer proposes a new vector to add to the cell state. Ten the LSTM update the cell state, by forgetting the information that we decided to forget, and updating it with the new vector values. It is calculated as:

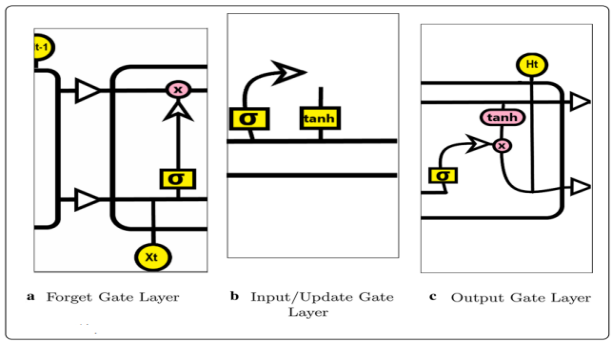

Fig. 4: LSTM Layer

$$i_t = \sigma(w_i[h_{t-1}, x_t] + b_i) \quad (2)$$

and

$$\tilde{C}_t = tanh(w_c[h_{t-1}, x_t] + b_c) \quad (3)$$

Output Layer: decides what will be our output by executing a sigmoid function that decides which part of the cell LSTM is going to output, the result is passed through a Tanh layer (value between − 1 and 1) to output only the information we decide to pass to the next neuron. It is calculated as:

$$O_t = \sigma(w_o[h_{t-1}, x_t] + b_o) \quad (4)$$

and

$$h_t = O_t \times tanh(C_t) \quad (5)$$

Gated Recurrent Unit (GRU):-

Gated Recurrent Unit GRU was introduced in 2014 by Cho et al. To solve the vanishing gradient problem experienced by classical recurrent networks.

Same as LSTM, the input value interacts with the information from the previous state to calculate the different values of intermediate gates which will subsequently be used to decide on the value to be output. GRU is simplified and only update gate (zt) and reset gate (rt) are introduced. In GRU, the update (or input) gate decides how much input (xt) and previous output (ht-1) to be passed to the next cell and the reset gate is used to determine how much of the past information to forget. The current memory content ensures that only the relevant information needs to be passed to the next iteration, which is determined by the weight *W*. The main operations in GRU are governed by the following formulae.

Update gate:

$$z_t = \sigma\left(W_z * [h_{t-1}, x_t]\right)$$

Reset gate:

$$r_t = \sigma\left(W_r * [h_{t-1}, x_t]\right)$$

Table 1: Training parameter data of LSTM and GRU

Model	Sequential – RNN
Type	LSTM, GRU
Hidden Units	7
Input shape	1,1
Verbose	False
Output layer	(TimeDistributed(Dense(1)))
Loss Function	MAE (Mean Absolute Error)
Optimizer	ADAM
Compilation Time	0.01620 S
Total params	260
Trainable params	260
Non-trainable params	0
Epoch	100
Batch size	128

IV. SIMULATION RESULTS

Python is a general programming language and is broadly utilized in a wide range of disciplines like general programming, web improvement, programming advancement, information investigation, AI and so forth Python is utilized for this task since it is truly adaptable and simple to utilize and furthermore documentation and local area support is exceptionally huge.

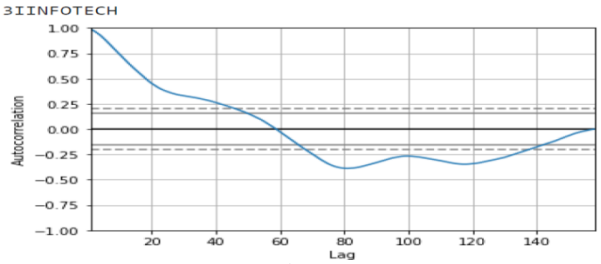

Fig. 5: AC of 3IINFORTECH

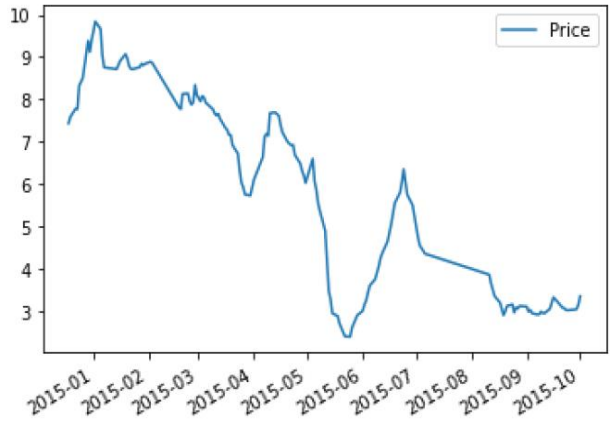

Fig. 6: Price of 3IINFORTECH

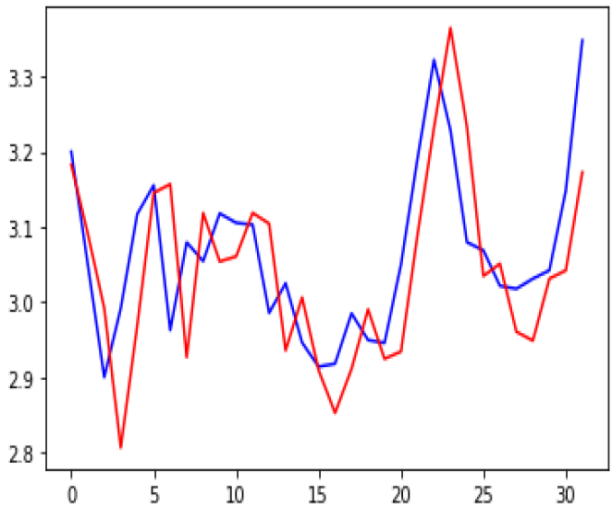

Fig. 7: Prediction and Real value of 3IINFORTECH

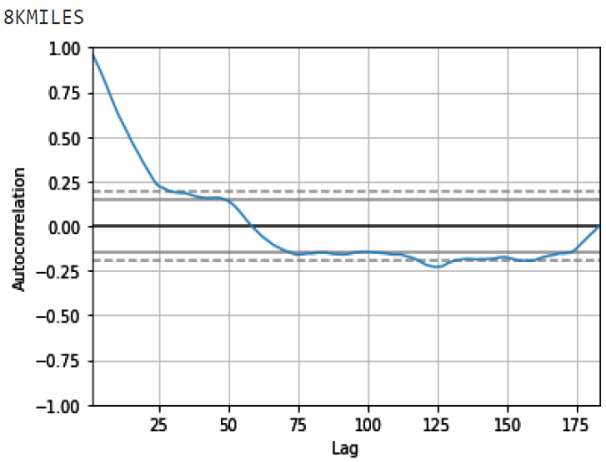

Fig. 8: AC of 8KMILES

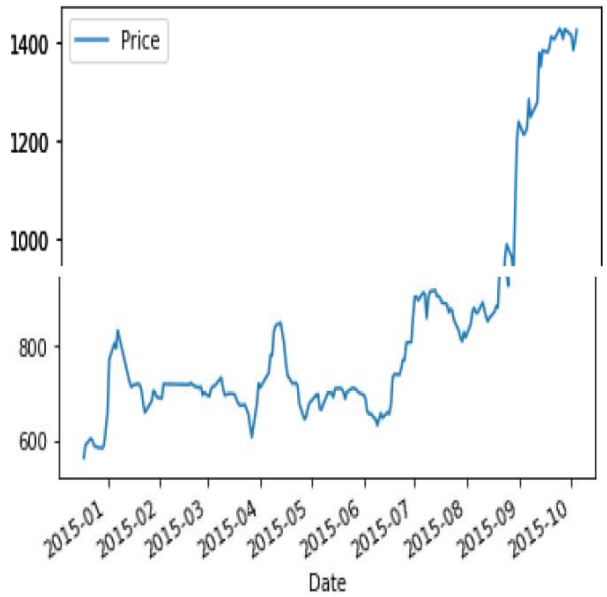

Fig. 9: Price of 8KMILES

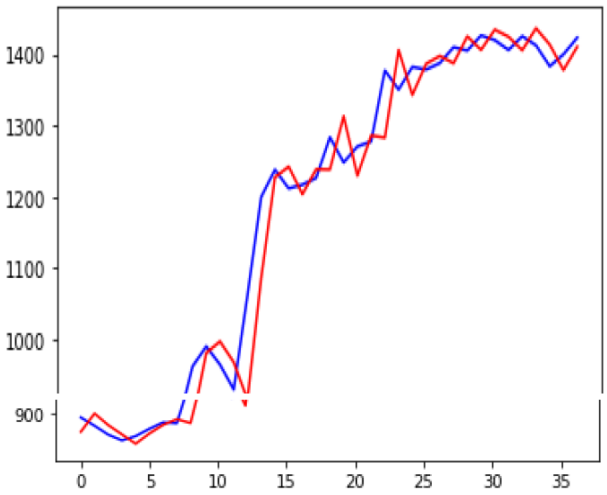

Fig. 10: Prediction and Real value of 8KMILES

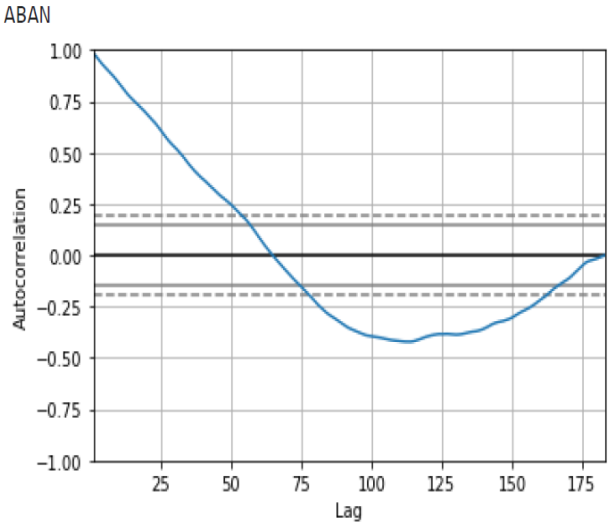

Fig. 11: AC of ABAN

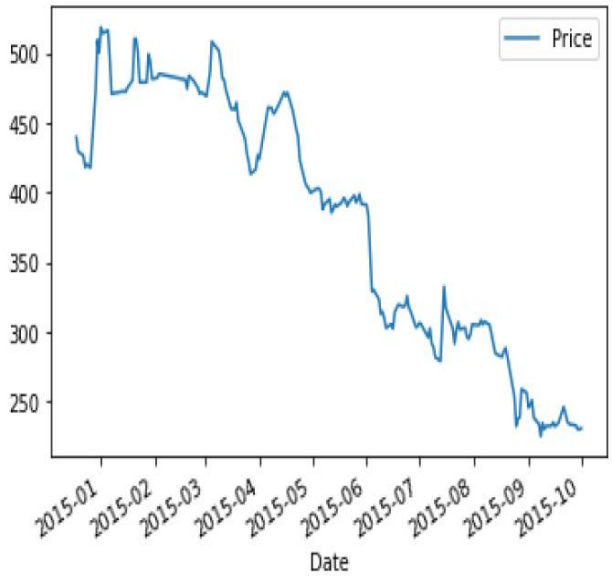

Fig. 12: Price of ABAN

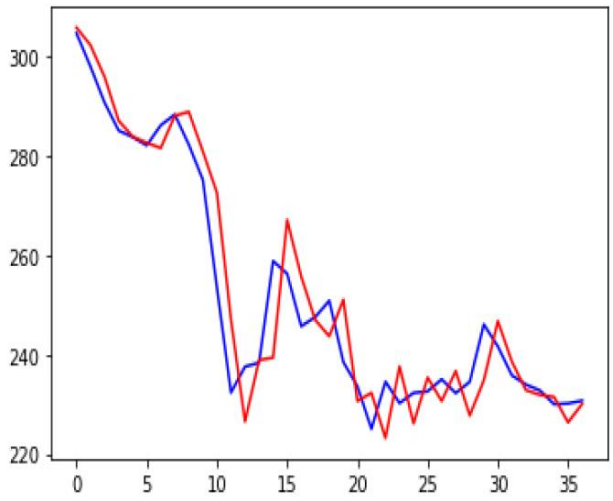

Fig. 13: Prediction and Real value of ABAN

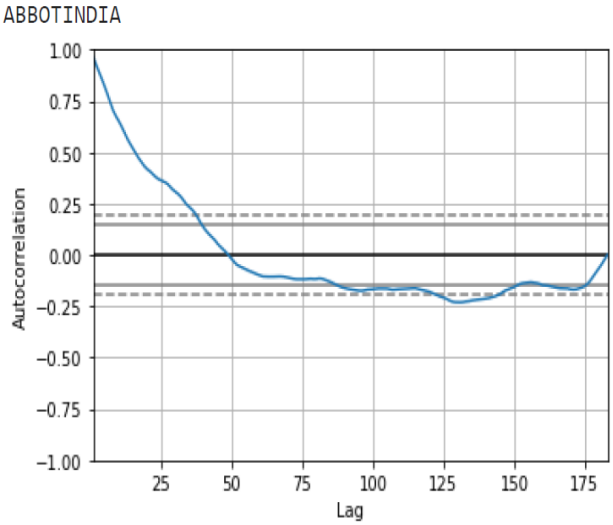

Fig. 14: AC of ABOUTINDIA

Fig. 15: Price of ABOUTINDIA

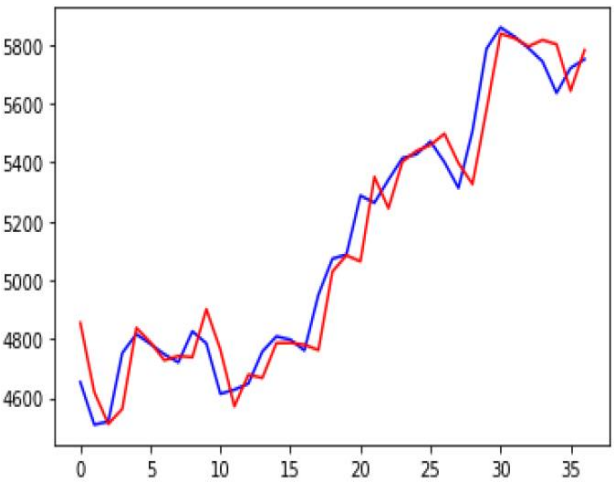

Fig. 16: Prediction and Real value of ABOUTINDIA

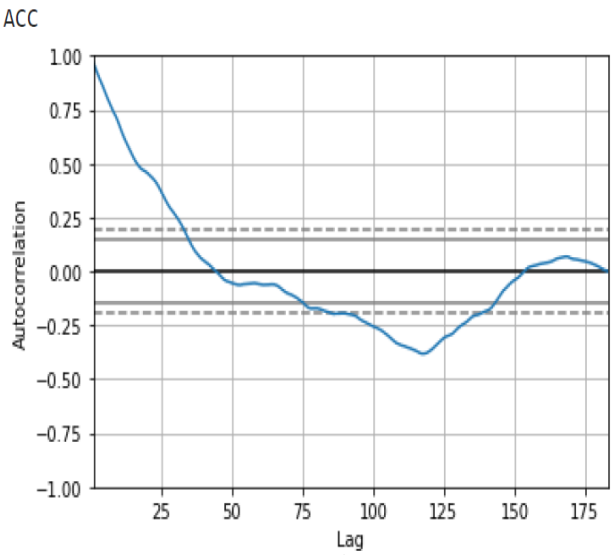

Fig. 17: AC of ACC

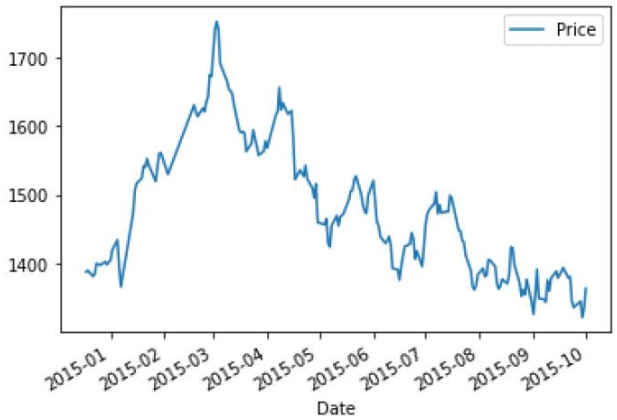

Fig. 18: Price of ACC

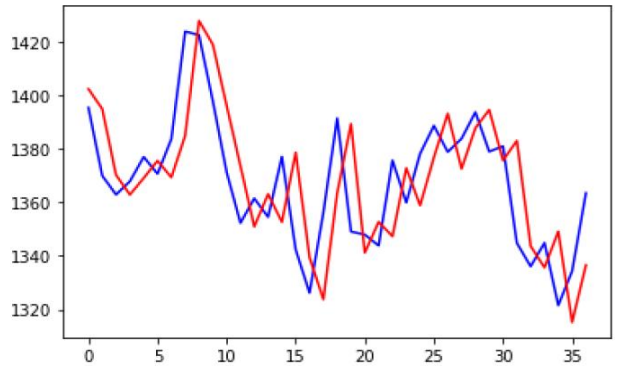

Fig. 19: Prediction and Real value of ACC

V. CONCLUSION

To examine and study how the share prices move and whether they are inclined towards a bullish or a bearish trend during any season or a particular period recurrently over years. The Study has been divided into two parts: the Macro level & the micro level. At the macro level the seasonality pattern is analyzed by reviewing three major indices of Indian stock market namely SENSEX, BSE100 & NIFTY. Once the pattern has been identified at the macro level, 43 companies representing the micro level were analyzed to examine whether the said pattern exists or not. The micro level samples include companies listed in Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). Each company is selected either from SENSEX, BSE100, NIFTY or CNX NIFTY Junior, if they are consistently listed in each stock market indicator during the study period.

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