

Recurrent Neural Networks(RNN) Techniques in Predicting Stock Price Direction : A Review

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Abstract—Investment in Stock Market is highly Beneficial as well risky. Predicting in any field is a challenging task. The highly volatile nature of Stock Market makes it more complicated in both investment and prediction. Thus, it is quite challenging for the researchers to design a model that can predict the direction of Stock Market. There are many types of researches to predict the direction of Stock Market using the different techniques of Computer Science and Economics. From the introduction of Machine Learning to this field gave more promising results. This paper investigates the use of Recurrent Neural Networks (RNN) in the field of predicting the direction of Stock Market. In this paper we will review the prediction of Stock Market with the help of Recurrent Neural Networks (RNN).

1. Introduction

Stock Market or Share Market is a place where the companies sell their shares to gather financial assistance for that company. There are millions of people who are investing the billions of rupees expecting for the profits. The estimated size of the share market in 2008 is 36.6 trillion dollars [1]. Due to the highly volatile and time varying nature makes it complicated to take right decisions at right time. To overcome this issue many of the researchers coming up the models that could predict the direction of the stock market. Introduction of Machine Learning techniques into stock market prediction has given promising results [2]. Traditionally the market can be seen by two analysis called technical analysis and Fundamental analysis [3].

1.1. Fundamental Analysis

Fundamental analysis given by Jeffrey S. Abarbanell and Brian J. Bushee [4] of a stock depends upon the company's assets liabilities and earnings. There are some factors that affect the Fundamental analysis of the stock like growth of the company, Earnings per share (EPS) suggested in [5], Return on Equity (ROE) [6], Return of capital employed (ROCE) as suggested by Thomas Arkan in [7].

1.2. Technical Analysis

Technical Analysis suggested by [8] is used to find the trends and patterns in the stock market and helps in prediction of stock price. By observing the market over a period of time one can find the patterns in it. Technical analysis helps the investors to identify the trends in the market and help them to make money out of it. Major tools used in Technical Analysis are

1.2.1. Relative Strength Index (RSI). :-

RSI was developed by J.Welles Wilder in [9], which is a momentum oscillator which measures the change of price movement. The range of RSI will be 0 to 100. The RSI value of 70 tells that the stock was overbought and the RSI value of 30 tells that the stock was oversold.

Formula given by Luckyson Khaidem in [10] to calculate the RSI was :-

$$RSI = 100 - (100/(1+RS))$$

$RS = (\text{Average gain over past 14 days})/(\text{Average loss over past 14 days})$

1.2.2. Stochastic oscillator. :-

Stochastic oscillator according to [11] is a momentum Indicator which uses support and resistance Levels. It attempts to predict price turning points by comparing closing price of a security to its price range.

Formula to calculate stochastic oscillator is

1.3. Artificial Neural Networks

Artificial Neural Networks are systems learn tasks with the help of examples, generally without task-specific programming. These are inspired from biological neural networks. ANNs are used in many fields like computer science, finance, economics, medical, business and many more, which is surveyed and given in [12].

1.3.1. Structure of ANN. Artificial neural networks have fundamental processing unit called neuron. The structure is similar to the structure of biological neural network [13] of central nervous system. The processing in the ANN is

similar to the central nervous system which works on the processing the signals between each other neuron [13]. The three main layers of the neural networks are input layer, output layer and hidden layer. For improving the performance of the model we can increase the hidden layers. The information mainly passes in the form of signals between the neurons. There can be any number of neurons in each layer. Every neuron in each layer has its own weight, biases and it is connected to every other neuron in the next layer. An activation function is used for the control the firing of the neuron [14]. The output of the network is the weighted sum of the input added with the biases and the activation function. There are many kinds of the artificial neural networks depends on the layers it uses. There are different types of the networks based on the number of the layers. As the number of hidden layers increases the complexity and the robustness of the network increases. If there are more than two hidden layers it is called as the deep neural network. There are different type of networks depending upon their architecture like feed forward network, Convolutional neural network, multi-level perceptron, recurrent neural network, single shot neural network, temporal neural network and so on [15].

1.4. Recurrent Neural Network (RNN)

Recurrent Neural Networks is an Artificial Neural Network but the connection between the units form a directed cycle. These are most powerful neural networks present right now. The RNN is mainly used in classification, caption generation, pattern reorganization and Voice generation so on. The method of processing makes it different and powerful than ANN. RNN gives better results with Long Short Term (LSTM) memory cell [20].

1.4.1. Structure of RNN. Recurrent Neural Network is similar to ANN but it has a new dimension called time. In RNN our Input data is passed into the cell along with output activation function and the respective output is included back into the cell as input. The decision making of the RNN depends upon the previous output, for example, the decision of n -1th time-step will affect the decision at n th time-step [21]. The time dependency in this model makes it more robust than the previous models like ANN. The working of RNN is basically the output of the n th time- step will be given back as input to the $n+1$ th time-step prediction. This gives us the good results compared to the previous models but has some problems like, all the outputs may not be useful for the next input and as the network grows bigger, harder the computing. To solve these problems there is a new model called Long Short Term Memory (LSTM).

1.4.2. Long Short Term Memory (LSTM) . Long Short Term Memory (LSTM) contains a special unites called memory block in the recurrent hidden layer. The LSTM introduces an intermediate type of storage called Memory cell. This memory block contains two blocks called as input bock and the output block. The flow of input activations

is controlled by input block and the output activations is controlled by output block . Same as the hidden layer in LSTM memory block there is forget gate [22]. The memory block has three gates namely input gate, forget gate and output gate. This LSTM is referred as vanilla LSTM. In addition to the forget gate the memory block has peephole connections from the internal cells to the gates in the same cell in order to get the precise timing of the output [23]. The LSTM cell is incorporated in to RNN to address the difficulty of learning for long term memory [24].As RNN output is taken back as the input to the next cell but not all the previous data is useful. To overcome this Deep LSTM [25] came into consideration with more gates like Keep gate and forget gate. In deep LSTM the forget gate was introduced by Gers et al [26] is a method to learn to flesh the contents of the internal state. The forget gate is a sigmoid layer and after every iteration it forgets irreverent parts of the previous state. The forget gate is useful in continuously running networks. The forget gate was not part of the original LSTM proposed in 2000. The LSTM Memory cell which is replaced by the hidden layer has input gate which controls the input activations, the output gate to control the output activations and the keep gate to retain the relevant parts and the forget gate forget the irrelevant parts combined with the RNN gives better results compared simple RNN and ANN.

2. Literature Review

E.schoneburg in [27] achieved a prediction accuracy of around 90in a short span of 10 days of by using the help of Neural Networks. By the use of Back Propagation Algorithm they got the absolute value prediction. The results they produced using neural networks conclude that we can achieve far more accuracy by using the Neural Networks

Wei wu, Jiuping Xu [28] stated that Fundamental Analysis is a very powerful tool to predict the stock price and the Technical analysis should be paid more attention to forecast a stock price. The correlation between Fundamental analysis and technical analysis will give a Major Improvement in predicting the stock price.

Debashish Das and Mohammad Shorif Uddin [29] stated that variety of techniques of Neural Networks are used to predict stocks. Data Mining and Neural Networks are used effectively to deal with Data that needs prediction. Neural Networks are used to extract useful information from a huge data set and data mining is used to predict future trends and behaviours.

Eldon Y. Li [30] have discussed about why neural networks are popular in the field of Business. He also stated that after the emergence of Multi-level and trainable ANN, they became the feasible options for Business models which requires solving complex equations and recognizing patterns from imperfect Inputs

Donald F. Specht [31] proved that the sigmoid activation function used in Neural Networks replaced with exponential function forms Probabilistic Neural Networks (PNN) that computes Non-linear Decision Boundaries which

approaches the Bayes optimal will be formed. It also stated that for an Application the PNN paradigm was 200,000 times faster than Back Propagation. It also discussed other advantage of PNN which is unlike many Networks, It operates completely in Parallel which doesn't need the feedback from the other Neurons to the Inputs.

Marijana Zekic in [32] discussed about the Importance and advantages of Neural Networks (NN) as an Artificial Intelligence (AI) methods over other statistical and other Methods that does not Include AI. The other uses of NN are I) NN can predict accurately in the situations of Uncertain Data and the combinations with the other Methods. Ii) NNs are mostly used in the predicting stock prices, although stock market prediction is an inexpedient process

Manna Majumder, MD Anwar Hussian in [33] discussed about the application of Artificial Neural Networks in forecasting the stocks in Indian Stock Market. It predicted the direction of closing value of an Index with a performance accuracy of 89.65 and with average accuracy of 69.72 over a span of four years. In extremely volatile markets like Indian stock markets the high performance measures of ANN, reported in the paper will be of extreme use and advise the Investors in Investing in the stocks.

Navpreetkaur in [34] discussed about the Data mining and Text Mining which is an application of Data Mining Techniques which will be help full in Gathering Information from the Text Documents. The Gathered Data will be useful for Market Analysis. They used SVM which uses Moving average algorithm to predict the stock price and the result of all the algorithms will check the duplicate and missing values and remove missing values.

3. Conclusion

It's been observed from the above references that the prediction of the stock market came to lime light after the introduction of the Machine learning techniques. The accuracy of the models increased after introduction of the artificial neural network. Researches is showing that the Recurrent Neural Networks combined with Long Short Memory cell are able to solve the classification problems with the good accuracy. Now a days all the traders are depending on the models that predict the direction of the stock market, so the accuracy will be the most important and the previous work suggests that the use of RNN with LSTM gives the better results. In future we can integrate RNN into the prediction of the direction of the stock market.

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References

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